Proceedings of the United States National Museum

SMITHSONIAN INSTITUTION • WASHINGTON, D.C.

Volume 112 | 1961 | Number 3449

REVISION OF THE MARINE SILVER HATCHETFISHES (FAMILY STERNOPTYCHIDAE)

By Leonard P. Schultz

This revision of the marine silver hatchetfishes, family Sternoptychidae, is based on specimens in the collections of the following institutions:

Academy of Natural Sciences of Philadelphia (ANSP)
Binghman Oceanographic Collections, Yale University (BOC)
British Museum (Natural History) (BM)
Chicago Natural History Museum (CNHM)
Institut Royal des Sciences Naturelles de Belgique (IRSNB)
Koninklijk Museum voor Midden-Afrika (=Musée Royal du Congo Belge) (KMMA)
Museum of Comparative Zoology, Harvard University (MCZ)
Scripps Institution of Oceanography (SIO)
Stanford Natural History Museum (SNHM)
Tulane University (TU)
University of California at Los Angeles (UCLA)
University of Miami, Marine Laboratory (UMML)
U.S. Fish and Wildlife Service (USFWS)
U.S. National Museum (USNM)
Woods Hole Oceanographic Institution (WHOI)

To the authorities of these institutions the author is grateful for loaning specimens and furnishing photographs and other data.

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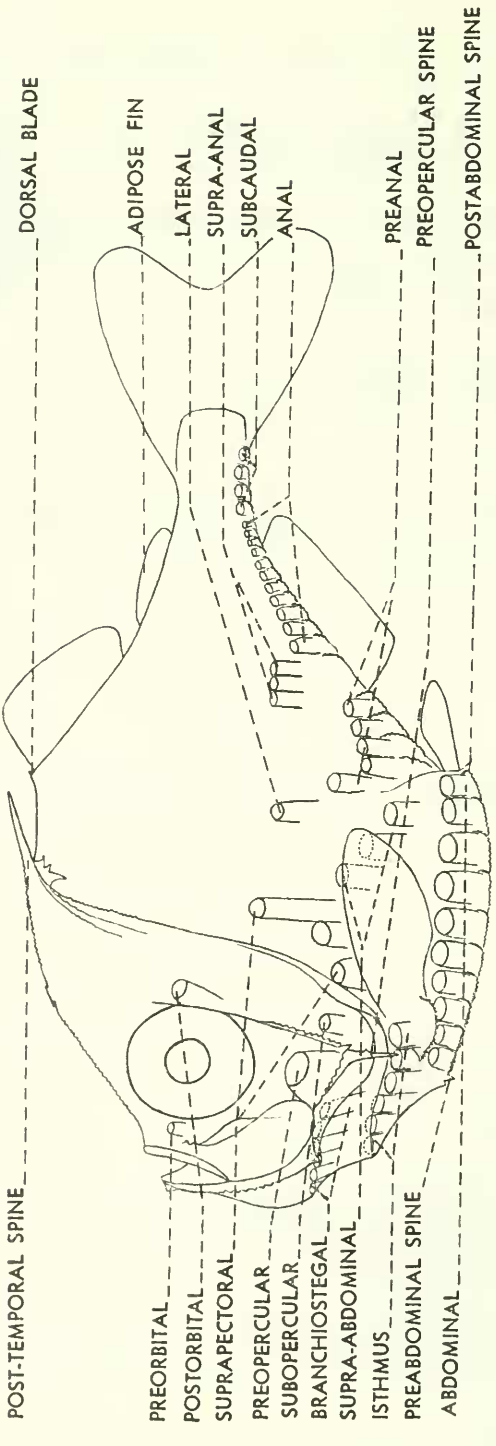


Figure 1.—Terminology used for the family Sternoptychidae. Drawing of *Polyipnus tridentifer* McCulloch, by Dorothea B. Schultz.

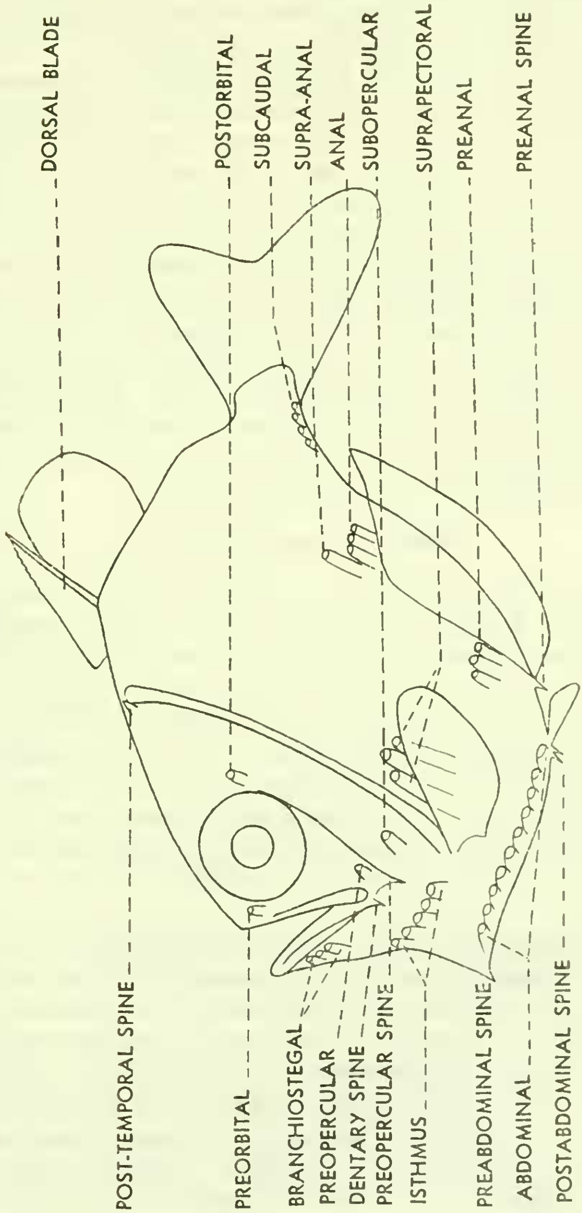


Figure 2.—Terminology used for the family Sternoptychidae. Drawing of *Sternoptyx diaphana* Hermann, by Dorothea B. Schultz.

The terminology used for the groups of photophores is presented in figures 1 and 2, on pages 588–589.

Each fin ray that has a separate base was counted, and all rudiments of gill rakers were counted on the first gill arch.

Radiographs were expertly made by Robert H. Kanazawa and T. John Leppi for the various genera and species of this family, and from those films the number of vertebrae are recorded in table 1, p. 591.

Gill (Proc. U.S. Nat. Mus., vol. 7, pp. 349–351, 1884) gives the relationships among the genera and a list of the family and subfamily synonymy. Gregory and Conrad (Copeia, No. 1, p. 27, 1936) discuss the relationships of the family Sternoptychidae with other forms. Wilimovsky (Copeia, No. 3, pp. 247–248, 1951) corrects the spelling of the family name. Hubbs (Copeia, No. 2, p. 97, 1953) thinks, as did earlier authors, that the family Sternoptychidae should be expanded to include Gonostomatinae and the Maurolicinae. Not having studied all the fishes in those relationships, I tentatively assign to the Sternoptychidae those genera with a dorsal blade, externally visible and in front of the soft dorsal fin.

Family Sternoptychidae

The marine silver hatchetfishes, family Sternoptychidae, may be distinguished as a group by the dorsal blade, which represents the highly specialized dorsal pterygiophores, externally evident in front of the dorsal fin. These pterygiophores may be fused into a thin plate as in *Argyropelecus*, a small pair of bony keels as in *Polyipnus*, or a single elongate spine as in *Sternoptyx*. Body thin, compressed, its depth very great; abdominal vertebrae 11, caudal vertebrae 17 to 29; branched caudal rays 9 + 8; scales probably present, very thin. The scales are usually lost in preservation, so that they are seldom seen, and thus from museum specimens no evaluation of their significance is possible.

The sternoptychids are deep-sea fishes with groups of characteristically arranged photophores for each genus, as are illustrated in the figures beginning on p. 623. They are caught in the open sea in plankton nets, trawls, and other gear in all temperate and tropical seas from the surface to considerable depths. Records from the Pacific indicate depths of 16,200 feet and from the Atlantic 12,704 feet. Such depths, however, are inadequately documented because closing nets were seldom used in oceanographic exploration. The fish could have been caught somewhere between the surface and the deepest point reached by the equipment.

The present study recognizes 9 species and 3 subspecies for *Argyropelecus*, 1 species for *Sternoptyx*, and 12 species and 2 subspecies for *Polyipnus*.

TABLE 1.—*Counts of vertebrae recorded for the Sternoptychidae.*

Genera, species, and subspecies	Number of Vertebrae												
	28	29	30	31	32	33	34	35	36	37	38	39	40
Argyropelecus													
affinis	—	—	—	—	—	—	—	—	—	—	2	3	1
pacificus	—	—	—	—	—	—	—	—	—	—	5	3	1
gigas	—	—	—	—	—	—	—	—	—	—	3	—	—
hemigymnus	—	—	—	—	—	—	—	—	—	15	9	—	—
intermedius	—	—	—	—	—	—	—	1	1	3	2	—	—
amabilis	—	—	—	—	—	—	—	12	2	—	—	—	—
aculeatus	—	—	—	—	—	—	5	14	5	—	—	—	—
olfersi	—	—	—	—	—	—	—	—	1	9	1	—	—
lynchus													
lynchus	—	—	—	—	—	—	—	3	8	3	—	—	—
sladeni	—	—	—	—	—	—	—	1	3	1	—	—	—
hawaiensis	—	—	—	—	—	—	—	—	6	1	—	—	—
Sternoptyx													
diaphana	1	11	2	1	—	—	—	—	—	—	—	—	—
Polyipnus													
polli	—	—	—	—	4	—	—	—	—	—	—	—	—
laternatus	—	—	—	—	3	1	—	—	—	—	—	—	—
triphanos	—	—	—	—	—	3	—	—	—	—	—	—	—
asteroides	—	—	—	—	13	12	1	—	—	—	—	—	—
matsubarai	—	—	—	—	—	5	—	—	—	—	—	—	—
fraseri	—	—	—	—	1	—	—	—	—	—	—	—	—
unispinus	—	—	—	—	—	—	—	1	9	—	—	—	—
nuttingi	—	—	—	—	—	24	3	—	—	—	—	—	—
indicus	—	—	—	—	1	2	—	—	—	—	—	—	—
tridentifer													
Western Australia	—	—	—	—	2	3	6	—	—	—	—	—	—
Philippines	—	—	—	—	—	4	40	2	—	—	—	—	—
spinosus													
spinosus	—	—	—	—	1	8	1	—	—	—	—	—	—
stereope	—	—	—	—	—	3	—	—	—	—	—	—	—

Key to the Genera of Sternoptychidae

1a. Abdominal photophores 12 and supra-abdominal 6; suprapectoral photophores 2; no supra-anal or lateral photophores, see figure 1, p. 588. Dorsal blade present and well developed in front of dorsal fin; on maxillary the anterior teeth point posteriorly, and posteriorly located ones point anteriorly . . . . **Argyropelecus** Cocco

1b. Abdominal photophores 10 and supra-abdimonal none to 3; suprapectoral photophores 3, dorsal blade present but very small and scarcely evident externally; none of the maxillary teeth point forward.

2a. Dorsal blade present represented externally by a long spine; photophores as follows: anal 3; branchiostegal 3; isthmus 5; preanal 3; supra-abdominal none; supra-anal 1; lateral none . . . **Sternoptyx** Hermann

2b. Dorsal blade evident externally as a short, low paired keel just in front of dorsal fin; photophores as follows: anal 4 to 15; branchiostegal 6; isthmus 6; preanal 5; supra-abdominal 3; supra-anal none to 3; lateral 1. **Polyipnus** Günther

TABLE 2.—*Counts recorded for certain species and subspecies of* Argyropelecus

Species and subspecies	Teeth pointing anteriorly on maxillary																			Teeth pointing posteriorly on maxillary												
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	1	2	3	4	5	6	7	8	9	10	11	12	13
affinis	—	—	—	1	1	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	1	—	1	—	—
pacificus	—	—	—	—	3	2	1	2	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	2	3	3	1	—	—	1	—	—
gigas	—	—	—	1	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2	—	—	—	—	—
hemigymus	—	—	—	—	1	—	2	—	1	4	—	1	1	—	—	—	1	—	1	—	3	1	3	2	—	2	—	—	1	—	—	—
intermedius	—	—	1	2	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	2	1	1	—	1	—	—	—	—	—	—	—	—
aculeatus	—	3	3	9	5	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2	8	2	7	1	—	—	—	—
olfersi	3	6	4	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	6	3	3	—	—	2	—	1
lynchus																																
lynchus	—	—	2	5	10	4	6	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	6	8	8	6	—	—	—	—
sladeni	—	—	2	3	3	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	1	1	2	—	1	1	—	—	—
hawaiensis	—	—	—	—	—	1	2	4	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	4	1	—	—

Species and subspecies	Number of fin rays: Dorsal			Pectoral				Anal				
	8	9	10	9	10	11	12	6	7	8	+5	6
affinis	—	4	—	—	2	1	—	2	2	—	3	1
pacificus	—	11	—	—	1	13	2	—	11	—	11	—
gigas	—	3	1	—	2	1	—	—	4	—	1	3
hemigymus	18	—	—	1	9	13	—	16	—	—	18	—
intermedius	6	3	—	—	5	3	—	7	—	—	7	—
amabilis	—	10	—	—	7	1	—	—	9	1	10	—
aculeatus	—	15	—	2	12	1	—	—	14	—	14	—
olfersi	—	13	—	—	6	6	—	—	12	—	12	—
lynchus												
lynchus	—	33	—	—	6	23	—	3	30	—	32	1
sladeni	—	10	1	—	7	2	—	—	10	—	10	—
hawaiensis	—	8	—	—	2	7	—	—	5	3	8	—

Species and subspecies	Number of gill rakers on first gill arch: Above angle					Below angle							Total gill rakers										
	7	8	9	10	11	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
affinis	—	2	—	—	—	—	—	—	2	—	—	—	—	—	—	—	2	—	—	—	—	—	—
pacificus	—	3	8	—	—	—	—	—	—	3	7	1	—	—	—	—	—	1	3	7	—	—	—
gigas	—	3	—	—	—	—	—	1	1	1	—	—	—	—	—	1	1	1	—	—	—	—	—
hemigymus	—	—	12	13	2	—	—	2	4	11	9	1	—	—	—	—	1	5	5	7	6	1	1
intermedius	1	3	2	1	—	—	—	—	3	4	—	—	—	—	—	1	2	1	2	1	—	—	—
amabilis	5	4	—	—	—	1	7	1	—	—	—	—	—	6	2	1	—	—	—	—	—	—	—
aculeatus	6	7	—	—	—	—	12	1	—	—	—	—	—	4	8	—	—	—	—	—	—	—	—
olfersi	5	6	—	—	—	4	7	—	—	—	—	—	1	7	3	—	—	—	—	—	—	—	—
lynchus																							
lynchus	1	31	1	—	—	—	3	26	4	—	—	—	—	—	4	24	5	—	—	—	—	—	—
sladeni	—	6	4	1	—	—	—	3	7	1	—	—	—	—	—	3	3	4	—	1	—	—	—
hawaiensis	—	6	1	1	—	—	—	—	4	4	—	—	—	—	—	—	3	4	1	—	—	—	—

TABLE 3.—*Measurements made on species and subspecies of* Argyropelecus, *expressed in thousandths of standard length*

Characters	*affinis*	*pacificus*	*gigas*	*hemigymnus*	*intermedius*	*amabilis*	*aculeatus*	*olfersi*	*lynchus lynchus*	*lynchus sladeni*	*lynchus hawaiensis*
Greatest depth (pigmented area) of body	414–455	502–528	524–526	531–643	530–561	742–820	749–886	660–820	646–700	582–682	584–612
Least depth of caudal peduncle	76–110	103–111	107–121	81–106	75–81	122–134	127–148	109–144	107–121	112–127	103–115
Length of snout	76–83	65–84	83–97	91–99	—	87–94	84–94	—	73–94	81–90	83–92
Diameter of eye	117–121	121–141	94–119	123–150	—	125–139	126–160	—	138–156	125–150	112–138
Length of maxillaries	246–290	254–263	223–244	274–298	—	297–333	297–332	—	313–345	277–307	272–292
Greatest height of dorsal blade	33–51	33–47	76–78	74–161	78–113	130–182	136–187	77–144	78–109	63–135	33–46
Length of groups of photophores:											
anal	202–235	224–255	210–223	98–123	107–131	122–151	116–164	133–159	145–161	122–173	176–183
preanal	102–134	106–115	103–116	85–108	88–99	111–123	110–136	108–124	103–117	92–148	113–121
subcaudal	121–148	129–134	129–146	43–64	42–53	65–75	68–74	61–81	81–100	69–100	83–86
Distance between groups of photophores:											
preanal to anal	8–19	7–14	6–12	56–81	45–58	24–41	20–36	26–42	21–35	14–29	23–27
anal to subcaudal	18–37	22–28	13–25	145–180	155–183	[a] 70–83	72–108	54–76	55–78	52–120	48–53
last abdominal (upper tip) to first preanal (upper tip)	60–94	106–113	112–114	172–220	155–179	255–285	258–300	198–264	195–220	150–188	150–164
Distance from orbit to upper preopercular spine	152–159	161–172	143–163	150–192	152–168	225–252	216–264	228–248	231–252	182–227	194–203
Postorbital length of body	803–857	806–830	818–820	767–823	807–863	755–832	772–848	806–842	788–831	780–836	800–856
Number of specimens	5	4	3	11	3	5	6	7	7	7	4

[a] 111 on a small specimen

Genus *Argyropelecus* Cocco

Argyropelecus Cocco, Giorn. Sci. Lett. Arti Sicilia, vol. 26, No. 77, p. 46, 1829 (type species *Argyropelecus hemigymnus* Cocco).

Sternoptychides Ogilby, Proc. Linn. Soc. New South Wales, ser. 2, vol. 3, p. 1313, 1888 (type species *Sternoptychides amabilis* Ogilby).

Pleurothyris Lowe, A history of the fishes of Madeira . . . , vol. 1, p. 64, 1843 (type species *Sternoptyx olfersi* Cuvier).

I consider the following unidentifiable:

Argyropelecus bocagei Osorio, Mem. Mus. Bocage, Lisbon, fasc. 1, p. 27, pl. 2, fig. 3, 1909 (type locality near Setúbal).—Seabra, Bull. Soc. Portugaise Sci. Nat., vol. 5, fasc. 3, p. 176, 1911 (Setúbal).—Nobre, Fauna marinha de Portugal, vertebrados, vol. 1, pt. 3, Peixes de Portugal, p. 350, 1935 (Setúbal).

Argyropelecus elongatus Esmark, Forh. Vid. Selsk. Christiana 1870, p. 489, 1871.

Species referable to the genus *Argyropelecus* have the following characters in common:

Abdominal vertebrae 11; caudal vertebrae 23 to 29; branched caudal fin rays 9+8; pectoral rays 9 to 12; dorsal 8 to 10; anal 6 to 8+5 or 6; gill rakers on first gill arch 7 to 11+8 to 14 totaling 15 to 25.

The number of organs in groups of photophores are as follows:

Abdominal 12; anal 6; branchiostegal 6; isthmus 6; preanal 4; preopercular 1; preorbital 1; postorbital 1; subcaudal 4; subopercular 1; supra-abdominal 6; suprapectoral 2; for location of groups of photophores see figure 1, p. 588. On the maxillary the dentition is characteristic because on the anterior part of that bone the teeth point posteriorly, and on its posterior part the teeth point anteriorly. The number of teeth pointing forward and aft is variable (see table 2, p. 592), the number appearing to increase slightly with increase in size.

Certain species, such as *aculeatus*, when sexual maturity is reached, develop spines around the subcaudal photophores and in front of them, between the divided anal fin, around the anus, on the dorsal blade, and on the ridges of the head. Both males and females may develop these spines.

The various species may be distinguished on the basis of counts of fins rays, gill rakers, and vertebrae and distribution and location of groups of photophores. In addition, the characteristics of the post-abdominal and preopercular spines are of utmost importance in the recognition of species and groups of species.

An important feature of the genus is the dorsal blade, which consists not of dorsal spines or rays but of more or less fused pterygiophores, the dorsal rays having been lost. Radiographs

show seven or eight of these pterygiophores, the last two somewhat fused together externally, but all forming a bony blade.

Another pecularity of the genus is the lack of anal pterygiophores opposite two or three vertebrae, usually beteeen the 9th to 12th caudal vertebrae. The pterygiophores that normally occur opposite these vertebrae are displaced anteriorly and posteriorly, where they are crowded between adjoining vertebrae.

In certain groups of photophores the organs in the postlarvae increase in number with increase in length up to a certain size, after which the full complement of light organs are formed. For example in *Argyropelecus hemigymnus*, the relationship of number of organs to standard length is:

Standard length in millimeters	*Number of organs in certain groups of photophores*		
	Preanal	*Anal*	*Subcaudal*
5. 7	3	2	3
7. 0	2	3	3
7. 0	2	3	3
7. 0	3	3	4
7. 5	2	3	4
7. 8	2	3	4
8. 0	4	4	4
8. 8	4	4	4
10. 0	4	5	4
10. 0	4	6	4
10. 0	4	6	4
10. 5	4	6	4
12. 0	4	6	4
12. 8	4	6	4
14. 5	4	6	4

These data indicate for *A. hemigymnus* that the full complement of photophores for the preanal, anal, and subcaudal groups is not reached until a standard length of about 10 mm. is attained. In *A. aculeatus* the anal photophores reach six in number at about 12 mm. in length.

Tables 1–3 give the counts and measurements that were made for certain species and subspecies of *Argyropelecus*.

Key to Species of *Argypropelecus*

1a. Supra-abdominal, preanal, anal, and subcaudal groups of photophores nearly in a straight and almost continuous line; 2 short postabdominal spines (occasionally lacking) about equal length, the acute angle between them about 10 to 15 degrees; lower preopercular spine directed downward and curving outward and forward; upper preopercular spine hooked outward and usually forward, not extending to bony edge of preopercle.

2a. No postorbital spine; dorsal blade short, length of exposed part of last spine above pigmented area contained about 2.2 to 3.3 times in base of soft dorsal; origin of base of soft dorsal on same level as pigmented base of dorsal blade; palatine teeth present, moderately strong.

3a. Lower edge of pectoral shield smooth or with only a few weak spines or scallops; greatest depth of pigmented body contained 2.1 to 2.4 times in standard length. (Atlantic Ocean and ? Indian Ocean.)
affinis Garman

3b. Lower edge of pectoral shield with spines or sharply pointed scallops; greatest depth of body contained 1.9 to 2.1 times in standard length. (East Pacific and Hawaiian Islands.) . . . . **pacificus,** new species

2b. One or two postorbital spines (usually two on adults); dorsal blade high, length of exposed part of last spine contained 1.5 to 1.9 times in base of soft dorsal; palatines toothless or with only a few feeble teeth; origin of base of soft dorsal notably above level of pigmented base of dorsal blade; greatest depth of pigmented part of body 1.9 to 2.0 times in standard length. Ventral edge of pectoral shield with sharp-pointed scallops. (Atlantic.) . . . . **gigas** Norman

1b. Supra-abdominal, preanal, anal, and subcaudal groups of photophores not in a straight or continuous line.

4a. A single postabdominal spine.

5a. Postabdominal spine with both edges serrated, directed backward and a little ventrally with a minute spinule on dorsoposterior base; lower preopercular spine nearly straight, directed almost straight downward; upper preopercular spine, rather long, curved a little dorsally, notably extending past rear bony edge of preopercle; preanal, anal, and subcaudal groups of photophores notably separated by wide spaces, the distance between the anal and subcaudal groups greater than the overall width of the group of anal photophores.

6a. Tip of longest spine in dorsal blade with one to three hooks or points; ventral edge of bony pectoral shield smooth. (Atlantic and Mediterranean.) . . . . **hemigymnus** Cocco

6b. Tip of longest spine in dorsal blade smooth, without hooks; ventral edge of bony pectoral shield with a few minute points, these are strongest in small specimens (15 mm. and shorter in standard length). (Central and Western Pacific and Indian Oceans.)
intermedius Clarke

5b. Postabdominal spine smooth edged, directed ventrally, and curved somewhat anteriorly; preopercle at lower angle with a spine pointing straight downward and curved a little outward, the upper preopercular spine small, pointing outward, its tip not extending past rear margin of bony edge of preopercle. (Atlantic Ocean and Lord Howe Island in the Pacific Ocean) . . . . **amabilis** (Ogilby)

4b. A pair of smooth postabdominal spines.

7a. Upper preopercular spine short, directed a little outward, not reaching or scarcely reaching past bony posterior edge of preopercle; lower preopercular spine directed downward and slightly curved forward and outward.

8a. Posterior postabdominal spine longer and heavier than anterior one, directed posteroventrally and sometimes with 1 or more spinlets on the ventral edge; angle between postabdominal spines 70 to 100 degrees; anterior postabdominal spine directed ventrally and curving forward, its length as long as or longer than lower preopercular spine; greatest depth of pigmented part of body 1.0 to 1.1, and length of dorsal blade 4.5 to 6.5 times, both in postorbital length of body. (Atlantic, Western and Eastern Pacific, and Indian Oceans.) . . . **aculeatus** Cuvier and Valenciennes

8b. Both postabdominal spines of about equal length and size; anterior postabdominal spine hooked anteroventrally, rear one usually shorter than anterior spine, without spinlets, and directed posteroventrally, angle between them about 60 degrees; greatest depth of pigmented part of body 1.2 to 1.4, and length of dorsal blade 7.5 to 9.5 times, both in postorbital length of body. (Atlantic, Western Pacific, and Indian Oceans.) . . . . . . **olfersi** (Cuvier)

7b. Upper preopercular spine long, reaching past posterior bony edge of preopercle; lower preopercular spine directed straight downward, sometimes curved a little forward and outward; the postabdominal spines diverge at an angle of about 50 to 65 degrees.

9a. Length of exposed part of longest spine of dorsal blade 1.0 to 2.2 times in base of soft dorsal fin.

10a. Total number of gill rakers on first gill arch 17 to 19, see table 2, p.592; teeth on maxillary pointing anteriorly 7 to 11, see table 2, p.592. (Eastern Pacific and Atlantic.)
lynchus lynchus Garman

10b. Total gill rakers 18 to 22; teeth on maxillary pointing anteriorly 6 to 10. (Western Pacific and Indian Oceans.)
lynchus sladeni Regan

9b. Length of exposed part of longest spine of dorsal blade 2.6 to 3.0 in base of soft dorsal fin; gill rakers total 20 or 21; teeth in maxillary pointing anteriorly 9 to 13. (Hawaiian Islands.)
lynchus hawaiensis, new subspecies

Argyropelecus affinis Garman

Figure 3

Argyropelecus affinis Garman, Mem. Mus. Comp. Zool., vol. 24, p. 237, 1899 (type locality, *Albatross* station 2117, lat. 15°24′40″ N., long. 63°31′30″ W., depth 683 fathoms; holotype USNM 44593).—Brauer, Sitz. Gesellsch. Beförd. Ges. Naturw. Marburg, p. 120, fig. 1, 1901 (anatomy).—Brauer, Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dampfer *Valdivia*, 1898–1899 . . . , vol. 15, pt. 1, p. 103, figs. 43–44, pl. 7, fig. 1, 1906 (Atlantic and ? Indian Oceans, depths 1,000 to 3,396 meters); pp. 197–204, figs. 9–11, pl. 37, 1908 (anatomy eye).—? Regan, Trans. Linn. Soc. London, ser. 2, Zool., vol. 12, pt. 3, p. 218, 1908 (Farquhar Atoll, 750 to 1,000 fathoms).—Murray and Hjort, The depths of the ocean . . . , p. 612, pl. 2, 1912 (Atlantic).—Jespersen, Report on the Danish oceanographical expeditions to the Mediterranean, 1908–1910, vol. 2, No. 3, pt. A2, p. 6, 1915 (Eastern Atlantic).—Barnard, Ann. South African Mus., vol. 21, pt. 1, p. 152, pl. 8, fig. 1, 1925 (lat. 31° S., long. 8° E., depth 1,000 fathoms).—Jordan, Evermann, and Clark, Report U.S. Comm. Fish. 1928, pt. 2, p. 74, 1930 (name only).—Norman, *Discovery* reports, vol. 2, p. 301, fig. 9, 1930 (Eastern North Atlantic, 400–450 meters).—Beebe, Bull. Inst. Oceanogr. Monaco, No. 629, p. 4, 1933 (off Bermuda, 400 fathoms).—Roule and Angel, Resultats des campagnes scientifiques accomplies par le Albert I, Monaco, fasc. 86, p. 46, 1933 (Azores and Madeira Islands).—Jespersen *in* Joubin, Faune ichthyologique de l'Atlantique nord, No. 15, fig., 1934 (North Atlantic).—Fowler, Bull. Amer. Mus. Nat. Hist., vol. 70, pt. 1, p. 246, fig. 115, pt. 2, p. 1208, 1936 (after Brauer).—Beebe, Zoologica, New York, vol. 22, pt. 3, p. 201, 1937 (Bermuda).—Parr, Bull. Bingham Oceanogr. Coll., vol. 3, art. 7, p. 49, 1937.—Schultz, Smithsonian Misc. Coll., vol. 91, No.

27, p. 4, 1937 (detailed measurements); Proc. U.S. Nat. Mus., vol. 86, p. 147, 1938 (Western North Atlantic).—? Norman, John Murray Expedition, 1933–34, Scientific reports, vol. 7, No. 1, p. 20, 1939 (Indian Ocean, depths 400 to 3,872 meters).—Nybelin, Göteborgs Vet. Vitterh. Samh. Handl., ser. B., vol. 5, No. 16, p. 23, 1948 (Eastern North Atlantic).— ? Smith, The sea fishes of southern Africa, p. 107, 1949 (off the "Cape" in 1,000 fathoms).—Marshall, Aspects of deep sea biology, New York, p. 278, figs. XI, 6–7, 1954.— ? Fowler, Fishes of the Red Sea and southern Arabia, Jerusalem, vol. 1, p. 86, 1956 (Red Sea).— ? Guenther and Deckert, Creatures of the deep sea, New York, p. 119, fig. 79, 1956 (all oceans).

Argyropelecus hemigymnus, Goode and Bean, Oceanic ichthyology . . . , U.S. Nat. Mus. Spec. Bull., No. 2, p. 126, pl. 39, fig. 147, 1895 (figure of holotype of *A. affinis*, USNM 44593 and USNM 31709).—Griffini, Ittiologia italiana . . . ed. Hoepli, p. 261, fig. 141, 1903 (Mediterranean).

Argyropelecus olfersi, Barnard, A pictorial guide to South African fishes, marine and fresh water, p. 48, pl. 6, fig. 14, 1947 (South Africa).

Argyropelecus, Beebe, The *Arcturus* adventure, New York, pp. 65, 390, pl. 8 in color, 1926 (lat. 26°43′ N., long. 48°52′ W.).

Study material: MCZ, *Atlantis* station 2994, lat. 23°24′ N., long. 80°50′ W., depth 565–585 fathoms, February 15, 1938, 1 specimen, 48 mm. USNM 44593, holotype of *A. affinis*, *Albatross* station 2117, lat. 15°24′40″ N., long. 63°31′30″ W., depth 683 fathoms, standard length 31.5 mm. USNM 31709, *Albatross*, August 18, 1882, lat. 39°56′ N., long. 70°35′ W., depth 245 fathoms, 1 specimen, 22.5 mm. USNM 102776, Johnson-Smithsonian Expedition, February 9, 1933, off Puerto Rico, 180 to 360 fathoms, 1 specimen, 39 mm. USNM 102778, off Puerto Rico, Johnson-Smithsonian Expedition, February 1933, depth 250 to 320 fathoms, 1 specimen, 25 mm. USNM 185536, *Pelican* station 31, April 10, 1956, lat. 29°36′ N., long. 80°06′ W., depth 180 to 210 fathoms, 1 specimen, 43.5 mm. CNHM 64367, *Oregon* station 1955, September 17, 1957, lat. 16°48′ N., long. 82°33′ W., depth 550 fathoms, 1 specimen, 59 mm. CNHM, *Combat* station 304, lat. 31°50′ N., long. 79°14′ W., 180 fathoms, 5 specimens, 48 to 64 mm. CNHM, *Combat* station 301, lat. 32°15′ N., long. 78°49′ W., 215 fathoms, 1 specimen, 64 mm.

Distinctive characters: Three species of *Argyropelecus* form what may be called the *affinis*, *gigas*, and *pacificus* complex, characterized by the supra-abdominal, preanal, anal and subcaudal photophores almost forming a continuous series and the dorsal tips of the photophores being nearly in a straight line. Lower preopercular spine points downward and curves outward and forward; upper preopercular spine short, pointing outward, and usually curving forward, never extending posteriorly; two posterior abdominal spines, both short and directed downward, forming an acute angle between them of about 10° to 15°; space between anal group and subcaudal group of photophores very narrow, about equal to width of last anal photo-

phore. In these three species the dorsal blade is low, as is indicated in the key on p. 595.

Description: Counts made are given in table 1, p. 591, and table 2, p. 592; the measurements made are given in table 3, p. 593. The photophores are arranged as shown in figure 3, p. 623.

Greatest depth of body 2.1 to 2.4 in standard length; exposed part of longest spine in dorsal blade 2.2 to 2.9 times in length of base of soft dorsal; no postorbital spine; ventral edge of pectoral shield without sharp points although edge is somewhat scalloped.

Color: The color pattern is shown in figure 3, p. 623.

Range: This pelagic species lives in considerable depths of the ocean. It probably is confined to the Atlantic Ocean and is replaced in the Pacific Ocean by *A. pacificus*, which is a very close relative. I have not been able to check the specimens reported from the Indian Ocean. I studied 12 lots from the Atlantic Ocean as follows: 1 specimen from off Delaware, 5 off Georgia; 3 off Florida, 2 from the Carribean, 1 from off Jamaica; 2 off Puerto Rico, 1 from Lesser Antilles, and 1 from Gulf of Mexico. It has been taken as far south as lat. 31° S. (Barnard, 1925) and as far north as lat. 39°56′ N. (USNM 31709); Norman (1939) reports depths of capture to 3,872 meters, but since closing nets were not used this depth is uncertain. The usual depths are less than 1,000 fathoms.

Argyropelecus pacificus, new species

Figure 4

Argyropelecus affinis, Townsend and Nichols, Bull. Amer. Mus. Nat. Hist., vol. 52, p. 11, 1925 (off Lower California in 868 to 930 fathoms).—Ulrey, Journ. Pan-Pacific Res. Inst., Honolulu, vol. 4, No. 4, p. 3, 1929 (off California).—Terron, Anal. Inst. Biol. Univ. Nac. Mexico, p. 76, 1932 (on Ulrey).—Haig, Pacific Sci., vol. 9, p. 321, 1955 (off Mauna Loa lava flow, Hawaii).

Holotype: USNM 164000, Mauna Loa lava flow, Kona, Hawaii, June 6, 1950, collected by Gosline, Hays, and Keen, standard length 56.5 mm.

Paratypes: USNM 87563, *Albatross* station 5686, April 22, 1911, lat. 26°14′ N., long. 114° W., depth 930 fathoms, 1 specimen, 40 mm. USNM 177930, Mauna Loa lava flow, Kona, Hawaii, June 6, 1950, 1 specimen, 57 mm. collected by Y. Yamaguchi. SIO S10–54–83A, California off San Diego, lat. 32°51.5′ N., long. 117°45′ W., to lat. 33°05.5′ N. and long. 117°58′ W., November 4, 1954, no depth given, 5 specimens, 33 to 58 mm. SIO S10–55–258, Southwest of Galápagos Islands, lat. 2°0′–3′ S., long. 90°33′–54′ W., depth zero to 925 fathoms, June 26, 1956, 9 specimens, 8 to 67 mm.

The following paratypes are in the collections of the Stanford Natural History Museum (all SNHM numbers): 46542, lat. 0°0′ N.,

long. 91°53′ W., June 13, 1925, 1 specimen, 15 mm; 46533, lat. 3°52′ N., long. 86°43′ W., 600 fathoms, 1 specimen, 21 mm.; 46525, lat. 0°17′ N., long. 90°02′ W., depth 500 fathoms, April 11, 1925, 2 specimens, 9 to 13 mm.; 46591, *Arcturus* station 5912 74–Pt–3, 60 miles south of Cocos Island at lat. 4°50′ N., long. 87°00′ W., depth 620 fathoms, May 25, 1925, 1 specimen, 41 mm.; 46617, *Arcturus* station 5866B, lat. 4°50′ N., long. 87°00′ W., depth 600 fathoms, May 25, 1925, 1 specimen, 25 mm.; 46619 *Arcturus* station 5917, lat. 4°50′ N., long. 87°00′ W., depth 450 fathoms, 1 specimen, 10 mm.

Description: Five specimens were measured in detail and these data, expressed in thousandths of the standard length, are recorded, respectively, for the holotype then the paratypes; standard lengths in mm. are 56, 45, 46.4, 46, and 58. Greatest depth of pigmented area of body 455, 528, 502, 506, and 516; least depth of caudal peduncle 98, 111, 110, 109, 83; greatest height of dorsal blade 36, 38, 47, 33, and 36; postorbital length of body 839, 806, 830, 815, and 827. Length of groups of photophores: Anal 213, 255, 224, 228, and 229; preanal 116, 109, 106, 109, and 115; subcaudal 139, 129, 134, 133, and 131. Distance between preanal and anal groups of photophores 11, 7, 9, 11, and 14. Distance between anal and subcaudal groups of photophores 18, 27, 22, 28, and 26. Distance from upper edge of last abdominal photophore to upper edge of first preanal photophore 88, 109, 106, 113, and 110. Distance from orbit to base of upper preopercular spine 152, 162, 168, 161, and 172. Distance from tip of snout to rear edge of maxillary 250, 262, 263, 254, and 259.

Counts made on the types are given in table 1, p. 591, and table 2, p. 592; measurements made are given in table 3, p. 593.

Color: The color pattern is shown in figure 4, p. 623.

Range: This species occurs in the eastern Pacific westward to the Hawaiian Islands. It has been taken to a depth of 930 fathoms (USNM 87563).

Remarks: This species differs from its closest relatives, *A. affinis* and *A. gigas*, as indicated in the key on p. 595.

Argyropelecus gigas, Norman

Figures 5, 26*a*

Argyropelecus gigas Norman, *Discovery* reports, vol. 2, p. 302, fig. 10, 1930 (type locality, Eastern Atlantic Ocean).—Fowler, Bull. Amer. Mus. Nat. Hist., vol. 70, pt. 2, p. 1208, 1936 (after Norman).—Parr, Bull. Bingham Oceanogr. Coll., vol. 3, art. 7, p. 49, 1937 (after Norman).—Schultz, Proc. U.S. Nat. Mus., vol. 86, p. 147, 1938 (on Norman).—Noronha and Sarmento, Vertebrados da Madeira, ed. 2, Peixes, vol. 2, p. 141, 1948 (Maderia).—Maul, Lísta sistemática dos peixes assinalados nos mares da Madeira e índice alphabetica, p. 13, 1949 (Madeira); Bol. Mus. Mun. Funchal, No. 4, art. 9, p. 17, fig. 6, 1949 (Madeira).—Marshall, Aspects of deep sea biology, New York, p. 111, fig. V, 15, 1954.

Argyropelecus affinis, Jespersen *in* Joubin, Faune ichthyologique de l'Atlantique nord, No. 15, fig., 1934 (Cape Verde Islands).

STUDY MATERIAL: MCZ 37641 *Captain Bill II* station 92, July 25, 1952, lat. 42°39′ N., long. 63°41′ W., depth 340 to 350 fathoms, 1 specimen, 44 mm. MCZ 37422, *Captain Bill II* station 48, June 26, 1952, lat. 39°56′ N., long. 69°37′ W., depth 360 to 445 fathoms, 1 specimen, 57 mm. CNHM 45943, *Oregon* station 841, November 6, 1953, lat. 28°58′ N., long. 88°0′ W., depth 830 to 930 fathoms, 1 specimen, 90 mm. UMML 925, *Pelican* station 57, June 10, 1956, lat. 29°59′ N., long. 80°07′ W., depth 165–169 fathoms, 1 specimen, 79 mm. CNHM 64457, Gulf of Mexico, *Oregon* station 1302, May 26, 1955, lat. 28°53′ N., long. 87°58′ W., depth 890 fathoms, 1 specimen, 87 mm.

DISTINCTIVE CHARACTERS: The body deep, greatest depth contained about 1.9 to 2.0 times in standard length; dorsal blade high, height of last spine above pigmented area contained 1.5 to 1.9 times in length of base of soft dorsal; one or two small spines behind orbit.

Dr. N. B. Marshall, British Museum (Natural History) has examined the three types and finds that the postabdominal spines are the same as in *affinis*, as is shown in figure 26*a*, p. 634. The sketch of these spines sent with his letter of January 21, 1958, is greatly appreciated.

DESCRIPTION: The arrangement of photophores and other details of this species are represented in figure 5, p. 624. Counts made are given in table 1, p. 591, and table 2, p. 592; measurements made are given in table 3, p. 593.

COLOR: The color pattern is shown is figure 5, p. 624.

RANGE: So far this species has been found only in the Atlantic Ocean.

Argyropelecus hemigymnus Cocco

FIGURE 6

Argyropelecus emigymnus Cocco, Giorn. Sci. Lett. Arti Sicilia, vol. 26, No. 77, p. 146, 1829 (type locality, seas around Messina. The Italian spelling of "emi," meaning half, was corrected to "hemi" in later publications and has consistently been used by all authors since 1829. Therefore, through long usage I continue to use *hemigymnus*).

Argyropelecus hemigymnus Cocco, Isis (Oken), vol. 24, pt. 12, p. 1342, 1831 (type locality, "seas around Messina").—Bonaparte, Iconografia della fauna Italica . . . vol. 3, Pesci, fasc. 28, pl. 121, fig. 3, 1840 (Mediterranean Sea); Catalogo metodico dei pesci Europei, Napoli, p. 37, 1846 (Mediterranean).—Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 22, p. 398, 1849 (Mediterranean).—Lowe, Proc. Zool. Soc. London, pt. 18, p. 248, 1850 (Madeira).—Günther, Catalogue of the fishes in the British Museum, vol. 5, p. 385, 1864 (Mediterranean and Atlantic Ocean).—Canestrini, Fauna d'Italia, vol. 3, Pesci marini, pt. 2, p. 119, 1872.—Doderlein, Atti Accad.

Sci. Lett. Arti Palermo, new ser., vol. 6, p. 54, 1879 (Sicilia).—Moreau, Histoire naturelle des poissons de la France, Paris, vol. 3, p. 498, 1881 (Mediterranean).—Leydig, Die augenähnlichen Organe der Fische, Bonn, p. 26, pl. 2, figs. 13–14; pl. 3, figs. 19–20; pl. 4, figs. 22–27; pl. 5, figs 28–31; pl. 6, fig. 35, 1881 (anatomy).—Giglioli, Soc. Geogr. Italiana, Terzo Congresso Geogr. Internaz., vol. 2, pp. 195, 199, 207, 1881 (Mediterranean).—Facciola, Natur. Siciliano Giorn. Sci. Nat. 1882–83, p. 206, 1883 (Straits of Messina).—Goode and Bean, Bull. Mus. Comp. Zool., vol. 10, No. 5, pp. 186, 189, 220, 1883 (*Blake* station 315, lat. 32°18′40″ N., long. 78°43′ W., 225 fathoms, specimens not seen).—Vinciguerra, Ann. Mus. Civ. Stor. Nat. Genova, ser. 2a, vol. 2, p. 469, 1885 (Gulfo di Genova).—Günther, Report of the scientific results of the voyage of H.M.S. *Challenger* during 1873–76, vol. 22, p. 167, 1887 (between Shetland and Faröe Islands).—Jordan, Report U.S. Comm. Fish and Fisheries 1885, vol. 13, p. 833, 1887 (name only).—Vaillant, Expédition scientifiques du *Travailleur* et du *Talisman* pendant les années 1880–1883, Poissons, p. 103, 1888 (Eastern Atlantic).—Lütken, Vid. Medd. Naturhist. For. Kjøbenhavn 1891, p. 211, 1892 (North Atlantic).—Carus, Prodromus faunae Mediterraneae . . ., vol. 2, p. 568, 1893 (Mediterranean).—Damiani, Atti Soc. Lig. Sci. Nat. Geogr. Genova, vol. 7, p. 100, 1896 (Gulfo di Genova).—Jordan and Evermann, U.S. Nat. Mus. Bull. 47, pt. 1, p. 604, 1896.—Parona, Atti Soc. Lig. Sci. Nat. Geogr. Genova, vol. 9, p. 367, 1898 (name only).—Handrick, Zoologica, Stuttgart, vol. 13, pt. 32, pp. 1–68, pls. 1–6, 1901 (anatomy of nervous systems and light organs).—Collett, Forh. Vid. Selsk. Christiania 1903, No. 9, p. 110, 1903 (Norway).—Lo Bianco, Mitth. Zool. Stat. Neapel, vol. 16, pp. 126–161, 1903 (Mediterranean).—Brauer, Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dampfer *Valdivia*, 1898–1899 . . ., vol. 15, pt. 1, p. 106, fig. 45, 1906 (Atlantic); pp. 197–204, figs. 9–11, pl. 37, 1908 (eye anatomy).—Ehrenbaum, Eier und Larven von Fishen. Teil 2. Nordisches Plankton, 10th lief., p. 357, 1909 (North Atlantic).—Zugmayer, Resultats des campagnes scientifiques accomplies par le Prince Albert I, Monaco, fasc. 35, p. 51, 1911 (Atlantic).—Murray and Hjort, The depths of the ocean . . ., p. 612, 1912 (Atlantic).—Holt and Byren, Fish. Ireland Sci. Invest. 1912, No. 1, p. 21, fig. 7b, 1913 (off Ireland).—Gilchrist, Mar. Biol. Report Union South Africa, vol. 1, p. 66, 1913 (South Africa).—Hoek, Conseil Perm. Inter. Expl. Mer. Pub. Circonst., No. 12, p. 53, 1914 (North Sea).—Pappenheim, Die Fische der deutschen Südpolar-Expedition 1901–1903, vol. 15, pt. 2, p. 182, 1914 (North and South Atlantic to a depth of 3,000 meters).—Pietschmann, Sitz. Akad. Wiss. Wien, vol. 123, pt. 4, p. 433, pl. 3, figs. 1–3, 1914 ("Najade" Adriatic Sea).—Jespersen, Report on the Danish oceanographical expeditions to the Mediterranean, 1908–1910, vol. 2, No. 3, pt. 2A, p. 7, 1915 (Atlantic and Mediterranean).—Jespersen and Taning, Vid. Medd. Naturhist., Kjøbenhavn, vol. 70, p. 220, 1919 (larvae).—Roule, Resultats des campagnes scientifiques accomplies par le Prince Albert I, Monaco, fasc. 52, p. 25, 1919 (Atlantic).—Nushbaum-Hilarowicz, Resultats des campagnes scientifiques accomplies par le Prince Albert 1st Monaco, fasc. 65, p. 10, pl. 2, figs. 1–13, 17–19; pl. 3, fig. 2, 1923 (histology, anatomy).—Jespersen and Taning, Report on the Danish oceanographical expeditions to the Mediterranean, 1908–1910, vol. 2, A12, p. 48, figs. 29–30, 1926 (Mediterranean).—Sanzo, Comit. Talassogr. Italiano Monogr. 2, pp. 1–60, pls. 1–7, 1928 (larvae and adults).—Beebe, Zoologica, New York, vol. 12, No. 1, p. 14, 1929 (Hudson Gorge, 164 to 1,000 fathoms).—

Jordan, Evermann and Clark, Report U.S. Comm. Fish. 1928, pt. 2, p. 74, 1930 (name only).—Norman, *Discovery* Reports, vol. 2, p. 303, pl. 2, fig. 4, 1930 (South Atlantic, surface to 2,500 meters).—Roule and Angel, Resultats des campagnes scientifiques accomplies par le Prince Albert I, Monaco, fasc. 79, p. 29, pl. 2, figs. 29–38, 1930 (larvae).—Sparta, Comit. Talassogr. Italiano Mem. No. 172, pp. 1–22, pl., 1930 (anatomy).—Sanzo, Fauna e flora del Golfo di Napoli. Pub. Staz. Zool. Napoli. Monog. 38, p. 44, pl. 4, figs. 1–4, 1931 (larvae).—Beebe, Bull. Inst. Oceanogr. Monaco, No. 629, p. 4, 1933 (off Bermuda, 300 to 400 fathoms).—Roule and Angel, Resultats des campagnes scientifiques accomplies par le Prince Albert I, Monaco, pt. 86, p. 80, 1933 (East Atlantic).—Jespersen *in* Joubin, Faune ichthyologique de l'Atlantique nord, No. 15, figs. 1, 2, 1934 (Mediterranean and North Atlantic).—Parr, Bull. Bingham Oceanogr. Coll., vol. 6, art. 6, p. 5, 1934 (lat. 25°39′ N., long. 77°18′ W.).—Nobre, Fauna marinha de Portugal, vertebrados, vol. 1, pt. 3, Peixes de Portugal p. 351, 1935 (Madeira).—Fowler, Bull. Amer. Mus. Nat. Hist., vol. 70, pt. 1, p. 245, pt. 2, p. 1207, 1936 (off Italy).—Sanzo, Soc. Italiana Progr. Sci., Roma, vol. 14, p. 9, 1936 (larvae).—Beebe, Zoologica, New York, vol. 22, pt. 3, p. 202, 1937 (Bermuda).—Parr, Bull. Bingham Oceanogr. Coll., vol. 3, art. 7, p. 53, fig. 18, 1937 (North Atlantic).—Schultz, Smithsonian Misc. Coll., vol. 91, No. 27, p. 4, 1937 (detailed measurements); Proc. U.S. Nat. Mus. vol. 86, p. 148, 1938 (western North Atlantic, Bermuda).—Rey, Mem. Real Acad. Cien. Exact. Fis. Madrid., vol. 11, p. 249, figs. 81a, 82, 1947 (Atlantic).—Trotti, Ann. Mus. Civ. Stor. Nat. Genova, vol. 63, p. 22, 1947 (Mediterranean).—Noronha and Sarmento, Vertebrados da Madeira, ed. 2, Peixes, vol. 2, pp. 115, 141, 1948 (Madeira).—Nybelin, Göteborgs Vet. Vitterh. Samh. Handl., ser. B, vol. 5, No. 16, p. 23, 1948 (eastern North Atlantic).—Maul, Lista sistemática dos peixes assinalados nos mares da Madeira e indice alphabetica, p. 13, 1949 (Madeira).—Tortonese and Trotti, Atti Accad. Lig. Sci. Lett. Genova, vol. 6, No. 1, p. 37, 1949 (Mediterranean).—Harvey, Bioluminescence, New York, p. 541, fig. 187, 1952.—Karvolac, Inst. Oceanogr. Ribarstvo Split. Jugoslavija, Rep., vol. 5, No. 2B, p. 16, 1953 (Adriatic Sea).—Zahl, Nat. Geog. Mag., vol. 104, p. 597, color plates, 1953 (Mediterranean).—Dieuzeide, Novelle, and Roland, Catalogue des poissons des côtes Algeriennes, vol. 2, p. 50, fig., 1954 (Mediterranean).—Zahl, Nat. Geogr. Mag., vol. 113, No. 5, p. 713, pl., 1958 (Mediterranean).

Sternoptix mediterranea Cocco, Giorn. Faro, Messina, vol. 4, anno. 6, p. 7, figs. 1, 2a–b, 1838 (Mediterranean).

Argyropelecus d'urvilli Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 22, p. 405, 1849 (Mediterranean).—Goode and Bean, Oceanic ichthyology . . . , U.S. Nat. Mus. Spec. Bull. No. 2., p. 127, 1895 (mid-Atlantic).

Argyropelecus heathii Harvey, Bioluminescence, New York, p. 541, fig. 184, 1952.

Study material: Since so many specimens were studied, they are summarized below; the numbers of specimens are given in parentheses:

ANSP 67703(1) and 67704(1).

BOC 2958(1), 2962(1), 2965(1), 2971(3), 2986–2998(49), 3001–3007(24).

CNHM (taken at Bermuda by the *Caryn*) 49789(1), 49793(2), 49792(1), 49787(1), 49795(2), 49799(2), 49797(1), 49796(1), 49798(1), 49790(1), 49791(2), 49788(2), 49784(7), 49802(2), 49811(1), 49805(2), 49800(2), 49803(1), 49808(1), 49813(1), 49801(1), 49806(1), 49812(1), 49809(1), 49810(1), 49804(1), 49807(1).

MCZ 6600(8), 25882(1), 26389(4), 32293(1), 34990(3), 34993(6), 35151(3), and *Atlantis* station 2959(1).

USNM 10143(2), 40053(2), 100341(1), 100526(1), 100542(1), 102779(5), 102780(8), 102781(3), 102782(8), 102783(1), 102784(2), 102785(2), 102786(6), 163362(1), 164296(3).

WHOI RHB454(13), RHB456(3), RHB483(2), RHB569(3), RHB572(7).

DISTINCTIVE CHARACTERS: *A. hemigymnus* and *A. intermedius* form what may be called the *hemigymnus* complex. The former appears to be confined to the Atlantic and Mediterranean Sea, and *A. intermedius* to the Pacific and Indian Oceans. My opinion is based on the specimens available. In each of these vast regions there may be populations or even subspecies that could be distinguished, but this possibility requires verification through special studies of hundreds of specimens from each of numerous localities.

The following characters are possessed by both species: Lower preopercular spine almost straight and directed nearly straight downward; upper preopercular spine rather long, curved a little upward and outward, notably extending past rear margin of bony edge of preopercle; a single serrated postabdominal spine directed posteriorly, the lower margin of spine almost in line with lower edge of abdomen, usually a minute spinule dorsally on posterior basal part of postabdominal spine.

DESCRIPTION: Counts made are given in table 1, p. 591, and table 2, p. 592, measurements made are given in table 3, p. 593. This species is notable for its slender body behind the preanal group of photophores, the compact nature of the anal and subcaudal groups of photophores, and the wide spaces separating preanal, anal, and especially the subcaudal group of photophores from the anal group. A white bar occurs between preanal and anal and another between anal and subcaudal groups of photophores. These white bars are separated by a dark bar.

RANGE: This species appears to be replaced in the Pacific and Indian Oceans by *A. intermedius*. *A. hemigymnus* is the only species of this genus that has so far been reported from the Mediterranean Sea. Numerous specimens were available for study in over 85 lots from the following general localities: Mediterranean Sea (54); Azores (9); off Iceland (4); vicinity of Bermuda (60); off New York (18); off South Carolina (1); off Georgia (1); Bahamas and West Indies (110); Caribbean Sea (1). I have not seen any specimen of *A. hemigymnus* from the Gulf of Mexico. The farthest north from which I have seen a specimen was lat. 42°56′ N., long. 30°19′ W. (MCZ 34990) and to a depth of 3,000 meters (Pappenheim, 1914). It also occurs in the South Atlantic.

Argyropelecus intermedius Clarke

Figure 7

Argyropelecus intermedius Clarke, Trans. Proc. New Zealand Inst. 1877, vol. 10, p. 244, pl. 6, figs., 1878 (type locality, Hokitika, New Zealand).

Argyropelecus heathi Gilbert, Bull. U.S. Fish Comm. 1903, vol. 23, pt. 2, p. 601, pl. 72, fig. 1, 1905 (type locality, Kaiwi Channel between Oahu and Molokai; holotype USNM 51632).—Jordan and Seale, Bull. U.S. Fish Comm. 1905, vol. 25, p. 190, 1906 (Hawaiian Islands).—Jordan and Jordan, Mem. Carnegie Mus., vol. 10, No. 1, p. 9, 1922 (Kaiwi Channel).—Fowler, Mem. Bernice Pauahl Bishop Mus., vol. 10, p. 35, 1928 (Hawaiian Islands); Acad. Nat. Sci. Philadelphia, monog. 2, p. 265, 1938 (Hawaiian Islands).—Haig, Pacific Sci., vol. 9, p. 321, 1955 (Mauna Loa lava flow, Hawaii).

Argyropelecus hemigymnus, Alcock, Journ, Asiatic Soc. Bengal, vol. 65, pt. 2, p. 331, 1896 (Bay of Bengal, 1803 fathoms); A descriptive catalogue of the Indian deep-sea fishes collected by the Royal Indian Museum . . . , Calcutta, p. 135, 1899 (Bay of Bengal, 1803 fathoms).—Brauer, Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dampfer *Valdivia*, 1898–1899 . . . , vol. 15, pt. 1, p. 106, 1906 (Pacific and Indian Oceans).—Gilchrist, Mar. Biol. Rep. Union South Africa, No. 1, p. 66, 1913 (South Africa).—Barnard, Ann. South African Mus., vol. 21, pt. 1, p. 153, 1925 (off Cape Point, South Africa, depth 156 to 630 fathoms).—Norman, British, Australian, and New Zealand Antarctic Research Expedition, 1929–1931, vol. 1, No. 2, Fishes, p. 82, 1937 (Pacific, off southwestern Australia).—? Smith, The sea fishes of Southern Africa, p. 107, fig. 160, 1949 (off the "Cape" in 600 fathoms).—Fowler, Mem. Bernice Pauahl Bishop Mus., vol. 12, p. 42, 1949 (Hawaiian Islands).—Munro, Handbook of Australian fishes, No. 7, p. 32, fig. 223, 1957 (off southwestern Australia).

Study material: Univ. Hawaii, Mauna Loa lava flow, Kona, Hawaii, June 6, 1950, 2 specimens, 19 to 25 mm. USNM 51632, holotype of *Argyropelecus heathi* Gilbert, *Albatross* station 4107, standard length 24.5 mm. UCLA H51–358, lat. 40°35′ N., long. 147°55′ W., August 10, 1951, depth 350 to 600 meters, 4 specimens, 12 to 30.5 mm. USNM 164004, off Kona, Hawaii, June 6, 1950, Y. Yamaguchi collector, 1 specimen, standard length, 19 mm. USNM 103022, *Albatross* station 5184, Philippine Islands, lat. 10°18′20″ N., long. 122°23′30″ E., depth 565 fathoms, 1 specimen, 15 mm. (another specimen in bad condition). USNM 103023, *Albatross* station 5120, Philippine Islands, lat. 10°18′30″ N., long. 122°23′30″ E., depth 393 fathoms, January 19, 1908, 1 specimen, 13.5 mm.

Distinctive characters: *A. intermedius* differs from *A. hemigymnus* in having the tips of spines of dorsal blade smooth, and in the ventral edge of the bony pectoral shield having a few minute points on the scalloped edges instead of the reverse as occurs in *hemigymnus*.

Description: Counts made are given in table 1, p. 591, and table 2, p. 592; measurements made are given in table 3, p. 593.

Color: The color pattern is shown in figure 7, p. 625.

RANGE: Although I have not seen any specimens from the Indian Ocean, this species probably replaces *hemigymnus* in the Central and Western Pacific and Indian Oceans. It occurs as far north as lat. 40°35′ N. and as deep as 565 fathoms in the Northwestern Pacific. Alcock (1896) had specimens from the Bay of Bengal from a depth of 1803 fathoms.

Argyropelecus amabilis (Ogilby)

FIGURE 8

Sternoptychides amabilis Ogilby, Proc. Linn. Soc. New South Wales, ser. 2, vol. 3, p. 1313, 1888 (type locality, Lord Howe Island).—Goode and Bean, Oceanic ichthyology . . . U.S. Nat. Mus. Spec. Bull. No. 2, pp. 127, 128, 1895.

Argyropelecus amabilis McCulloch, Rec. Australian Mus., vol. 14, No. 2, p. 118, pl. 14, fig. 3, 1923 (Lord Howe Island).—Parr, Bull. Bingham Oceanogr. Coll, vol. 3, art. 3, p. 49, fig. 21, 1937.

Argyropelecus amabilis, Schultz, Proc. U.S. Nat. Mus., vol. 86, p. 150, 1938 (Western North Atlantic). Longley and Hildebrand, Pap. Tortugas Lab. Carnegie Inst. Washington, No. 535, p. 16, 1941 (Florida).

Argyropelecus micracanthus Parr, Bull. Bingham Oceanogr. Coll., vol. 3, art. 7, p. 52, figs. 18, 21, 1937 (type locality, lat. 23°49′ N., long. 76°58′ W., depth 7,000 feet of wire out; holotype BOC 3768 examined by me).

Argyropelecus antrorsospinus Schultz, Smithsonian Misc. Coll., vol. 91, No. 27, pp. 1–5, fig. 1, 1937 (type locality, Western North Atlantic).

Argyropelecus olfersi, Goode and Bean (in part), Oceanic ichthyology . . . , U.S. Nat. Mus. Spec. Bull. No. 2, p. 126, pl. 39, fig. 148a, 1895 (USNM 33296; 33393; 35561; 43855; 102987).—Jordan and Evermann, U.S. Nat. Mus. Bull. 47, pt. 1, p. 604, pt. 4, fig. 261, 1896.—Roule and Angel, Resultats des campagnes scientifiques accomplies par le Prince Albert I, Monaco, fasc. 86, p. 48, (? p.80), pl. 2, figs. 24, 24a, 1933 (Azores, Gulf of Gasconge).—Vladykov and McKenzie, Proc. Nova Scotian Inst. Sci., vol. 19, pt. 1, p. 60, fig., 1935 (on Goode and Bean).

STUDY MATERIAL: USNM 102989 (holotype of *A. antrorsospinus*), off Calebra Island, lat. 18°32′54″ N., long. 65°23′42″ W., to lat. 18°32′15″ N., long. 65°18′45″ W., February 26, 1933, depth 250 to 320 fathoms, standard length 33 mm. USNM 102987 (paratype of *A. antrorsospinus*), *Albatross* station 2208, lat. 39°33′ N., long. 71°16′15″ W., August 21, 1884, 1 specimen, 34.5 mm. USNM 35561 (paratype of *A. antrorsospinus*), *Albatross* station 2209, lat. 39°34′45″ N., long. 71°21′30″ W., August 21, 1884, 1 specimen, 33 mm. USNM 33393 (paratype of *A. antrorsospinus*), *Albatross* station 2075, lat. 41°40′30″ N., long. 66°35′00″ W., September 3, 1883, 1 specimen, 34 mm. USNM 43855 (paratype of *A. antrorsospinus*), *Albatross* station 2717, lat. 38°24′ N., long. 71°13′ W., September 18, 1886, 1 specimen in bad condition. USNM 33296, *Albatross*, lat. 39° N., long. 68° W., 1 specimen, 54 mm. MCZ 35815, *Atlantis* station 3457, lat. 23°23′ N., long. 80°36′ W., May 3, 1938, 550 fathoms, 1 specimen, 37 mm. WHOI, *Blue Dolphin* haul No. RHB 481, August 25, 1953, lat. 39°44′

N., long. 70°39′ W., to lat. 39°48′ N., long. 70°28′ W., 2 specimens, 13.5 to 18 mm. BOC 3768 (holotype of *Argyropelecus micracanthus* Parr).

DISTINCTIVE CHARACTERS: Lower preopercular spine directed straight downward and curved a little outward; upper preopercular spine short, pointing outward, its tip not extending past rear margin of bony edge of preopercle; a single postabdominal spine directed downward and curved a little forward; space between anal group and subcaudal group of photophores about equal to width of last two anal photophores; supra-abdominal, preanal, and anal photophores not in a straight line; caudal peduncle crossed with a white or pale bar between anal and subcaudal groups of photophores.

DESCRIPTION: Counts made are given in table 1, p. 591, and table 2, p. 592; measurements made are given in table 3, p. 593. This deep bodied species, when it reaches a standard length of over 35 mm., develops spines along the ventral edge of the caudal peduncle, around the anus, and the ventral bony edge of the abdominal ridge becomes serrated; also three flat bonylike spines develop between the two parts of the anal fin; the space between anal and subcaudal groups of photophores is much greater in small specimens than in the adults.

COLOR: The color pattern is shown in figure 8, p. 625.

RANGE: This species occurs in the Atlantic Ocean and at Lord Howe Island in the Pacific Ocean to a depth of at least 550 fathoms and perhaps over 1,000 fathoms (Parr 1937).

REMARKS: *H. aculeatus* may be confused with *H. amabilis* when the posterior abdominal spine of *aculeatus* is damaged and only the anterior one remains.

Argyropelecus aculeatus Cuvier and Valenciennes

FIGURE 9

Argyropelecus aculeatus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 22, p. 406, 1849 (type locality, off the Azores).—Günther, Catalog of the fishes in the British Museum, vol. 5, p. 386, 1864 (Azores).—Sauvage, Histoire physique naturelle et politique de Madagascar, 1887–91, Paris, vol. 16 (Poissons), p. 483, pl. 48, fig. 5, 1875 (Reunion Island)—Goode and Bean, Oceanic ichthyology . . ., U.S. Nat. Mus. Spec. Bull. No. 2., p. 127, 1895 (mid-Atlantic).—Collett, Forh. Vid. Selsk. Christiania 1903, No. 9, p. 108, 1903 (off Norwegian coast); Zool. Anz., vol. 28, No. 21–22, p. 726, 1905 (on Collett, 1897).—Brauer, Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dempfer *Valdivia*, 1898–1899 . . ., vol. 15, pt. 1, p. 110, fig. 47, 1906 (Atlantic and Indian Oceans).—Murray and Hjort, The depths of the ocean . . ., p. 642, 1912 (Atlantic).—Hock, Conseil Perm. Intern. Expl. Mer. Pub. Circonst., No. 12, p. 53, 1914 (North Sea).—Jespersen, Report on the Danish oceanographical expeditions to the Mediterranean, 1908–1910, vol. 2, No. 3, pt. 2A, p. 27, 1915 (Atlantic).—Norman, *Discovery* reports, vol. 2, p. 303, fig. 11, 1930 (South Atlantic, surface to 1,000 meters).—Borodin, Bull.

Mus. Comp. Zool., vol. 72, No. 3, p. 68, 1931 (MCZ 31631).—Beebe, Bull. Inst. Oceanogr. Monaco, No. 629, p. 4, 1933 (off Bermuda from zero to 400 fathoms).—Roule and Angel, Resultats des campagnes scientifiques accomplies par le Prince Albert I, Monaco, pt. 86, p. 79, 1933 (East Atlantic).—Jespersen *in* Joubin, Faune ichthyologique de l'Atlantique nord., No. 15, fig., 1934 (North Atlantic).—Beebe, Zoologicia, New York, vol. 22, pt. 3, p. 201, 1937 (Bermuda).—Parr, Bull. Bingham Oceanogr. Coll., vol. 3, art. 7, p. 53, fig. 18, 1937 (North Atlantic).—Schultz, Smithsonian Misc. Coll., vol. 91, No. 27, p. 4, 1937 (detailed measurements); Proc. U.S. Nat. Mus., vol. 86, p. 151, 1938 (Gulf of Mexico, western North Atlantic).—Bertin, Bull. Mus. Nat. Hist. Nat. Paris, vol. 12, No. 6, p. 314, 1940 (holotype of *Argyropelecus aculeatus* Cuvier and Valenciennes, Azores).—Maul, Bol. Mus. Mun. Funchal, No. 4, art. 9, p. 17, fig. 5, 1949 (Maderia).—Marshall, Aspects of deep sea biology, New York, p. 278, fig. XI, 6, 1954.

Argyropelecus caninus Garman, Mem. Mus. Comp. Zool., vol. 24, p. 235, 1899 (type locality, Indian Ocean. The type of *A. caninus* Garman, was photographed by Harvard University through the kindness of Mrs. M. M. Dick, and the prints show the holotype to be badly damaged; preopercular spines are lacking, as is the rear postabdominal spine, the base of which has a ragged edge, indicating that it was broken off. There is little doubt that *A. caninus* is a synonym of *A. aculeatus*).

Argyropelecus acanthurus Fowler, Bull. Amer. Mus. Nat. Hist., vol 70, pt. 1, p. 246, pt. 2, p. 1207, 1936 (after Cuvier and Valenciennes).—Rey, Mem. Real. Acad. Cienc. Nat. Madrid, vol. 11, p. 254, figs. 81c, 84, 1947 (Atlantic).—Noronha and Sarmento, Vertebrados da Madeira, ed. 2, Peixes, vol. 2, p. 141, 1948 (Madeira).—Maul, Lista sistemática dos peixes assinalados nos mares da Madeira e indice alphabetica, p. 13, 1949 (Madeira).

Argyropelecus olfersi, Goode and Bean (in part), Oceanic ichthyology . . ., U.S. Nat. Mus. Spec. Bull., No. 2, p. 126, 1895 (USNM 35534, 35467, 38116, 38211, 74336).—Collett, Arch Math. Naturv. Christiana, vol. 19, No. 7, p. 14, 1897 (Azores).

Argyropelecus (*Sternoptychides*) *amabilis*, Whitley, Australian Zool., vol. 9, pt. 4, p. 404, fig. 12, 1940 (near Port Hacking, New South Wales).

Study material: Since many specimens were studied, they are summarized below; the numbers of specimens are given in parentheses:

CNHM 49187(1), 49785(2), 49786(1), 49828–49834(10), 49836(1), 64352(3), 64356(1), 64363–64366(9).

MCZ 28262(1), 31631(1), 32293(1), 34950(1), 34993(1); *Atlantis* station 2952(1), 2961B(1), 2962C(1).

SIO H53–356(1).

SNHM 43373(1), 44011(1), 44023(2), 44030–44031(12), 44034(1), 44037(1), 44065(1), 44073(1), 44075(1), 46026(1), 46524(1), 46527(15).

UMML 2322(1), 2324(1), 2336(1), 2746–2749(4).

USNM 35467(1), 35534(1), 38116(1), 38211(1), 74336(1), 86124(2), 102777(2), 103024(1); *Silver Bay* station 442(1), 443(2), 449(1); *Combat* station 291(1) and 444(1).

WHOI RHB 414(1), RHB 454(1), RHB 459(3) RHB 462(1), RHB471(2), RHB 475–476(52), RHB 478(3), RHB 555(1), RHB 569(1), RHB 588(3), RHB 593(1).

Distinctive characters: Lower preopercular spine directed downward and slightly curved outward; upper preopercular spine short,

directed a little outward and posteriorly but not extending beyond bony edge of preopercle; 2 postabdominal spines, the anterior one directed ventrally and curving a little forward, the rear spine much longer and stronger, directed posteriorly and curving ventrally; posterior spine sometimes with 1 or 2 spinelets on the ventral side; the angle between postabdominal spines about 70° to 100°; space between anal group and subcaudal group of photophores rather narrow, about equal to width of last 3 anal photophores; supra-abdominal, preanal, and anal photophores not in a straight line; caudal peduncle crossed with a white or pale bar between anal and subcaudal groups of photophores; translucent part of abdominal keel notably wider than width of middle two anal photophores.

Description: Counts made are given in table 1, p. 591, and table 2, p. 592; measurements made are given in table 3, p. 593. Greatest depth of pigmented part of body 1.0 to 1.1 and length of dorsal blade 4.5 to 6.5 times, both in postorbital length of body. When it reaches a standard length greater than 25 mm., this deep bodied species develops a series of spines under the subcaudal photophores, a double series in front of subcaudal photophores, and a double group around the anus and 3 flat bonylike spines between the 2 parts of the anal fin; the bony ridges on head and dorsal blade also develop series of bony serrae; these occur on both males and females.

The four subcaudal photophores of equal size are in a straight line, whereas the first and last two anal photophores are notably larger than the middle three and dorsal edges are not in a straight line.

In alcohol there is a white bar across caudal peduncle between anal and subcaudal group of photophores up to a length of about 50 mm., after which it darkens like rest of body; base of lower lobe of caudal fin with a blackish posterior extension at least one-fourth the length of lower caudal fin rays.

Some specimens are difficult to distinguish from *olfersi* if the postabdominal spines are damaged. However, *aculeatus* has a deeper body; the depth is less than 1.1 in postorbital length, whereas in *olfersi* it is 1.2 or greater.

Range: This species occurs in abundance in the Atlantic and Pacific Oceans and is also found in the Indian Ocean. Specimens were examined from the following localities: Pacific localities: Japan (1), Philippines (1), Galápagos (15), in Pacific off Colombia (1). Atlantic localities: Grand Banks (5), off New York (51), off Deleware (10), middle North Atlantic (2), off North Carolina (2), off South Carolina (1), vicinity of Florida (9), Gulf of Mexico (3), Bahamas (1), Cuba and West Indies (9), Burmuda (43), Caribbean (16), off Azores (2).

The farthest north locality in the Atlantic is lat. 48°10′ N. (MCZ 34950); and it has been taken at a depth of 855 fathoms.

***Argyropelecus olfersi* (Cuvier)**

FIGURE 10

Sternoptyx olfersii Cuvier, Le régne animal . . . , ed. 2, vol. 2, p. 316, 1829 (type locality, Atlantic Ocean).—Rüben and Koren, Vetensk. Akad. Handl. Stockholm 1844, p. 80, pl. 3, fig. 6, 1846 (Helgoland).

Argyropelecus hemigymnus, Borodin, Bull. Mus. Comp. Zool., vol. 72, No. 3, p. 68, 1931 (MCZ 31634).

Argyropelecus olfersi Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 22, p. 408, 1849 (off Cape of Good Hope, Western Atlantic).—Lowe, Proc. Zool. Soc. London, pt. 18, p. 247, 1850 (Madeira).—Günther, Catalog of the fishes in the British Museum, vol. 5, p. 386, 1864 (Atlantic).—Collett, Forh. Vid. Selsk. Christiana, No. 1, p. 84, 1880 (off Norway).—Collett, Nyt Mag. Naturv., vol. 29, p. 102, 1884 (off Norway).—Jordan, Report U.S. Comm. Fish and Fisheries 1885, vol. 13, p. 833, 1887 (name only).—Günther, Report of the scientific results of the voyage of H.M.S. *Challenger* during 1873–76, vol. 22, p. 167, 1887 (off Cape Finisterre).—Vaillant, Expeditions scientifiques du *Travailleur* et du *Talisman* pendant les années 1880–1883, Poissons, p. 104, 1888 (off Portugal).—Lilljeborg, Sveriges och Norges fiskar, Upsala, vol. 3, p. 3, 1891 (off Norway).—Lütken, Spolia Atlantica, p. 283, 1892 (North Atlantic).—Vinciguerra, Atti Soc. Italiana Sci. Nat. Milano, 1893, vol. 34, p. 331, 1893 (Canary Islands).—Smitt, A history of Scandinavian fishes, Stockholm, pt. 2, p. 925, fig. 233, 1895 (Atlantic, also 2nd edition).—Collett, Resultats des campagnes scientifiques accomplies par le Prince Albert I, Monaco, fasc. 10, p. 127, pt. 3, fig. 14, 1896 (off Azores).—Jordan and Evermann, U.S. Nat. Mus. Bull. 47, pt. 1, p. 604, pt. 4, fig. 261A, 1896.—Collett, Forh. Vid. Selsk. Christiania, No. 9, p. 105, 1903 (off Norwegian coasts).—Brauer, Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dampfer *Valdivia*, 1898–1989 . . . , vol. 15, pt. 1, p. 108, fig. 46, 1906 (Atlantic, Pacific and Indian Oceans).—Zugmayer, Resultats des campagnes scientifiques accomplies par le Prince Albert I, Monaco, fasc. 35, p. 52, 1911 (Atlantic).—Murry and Hjort, The depths of the ocean . . . , p. 612, 1912 (Atlantic).—Halkett, Checklist of the fishes of the Dominion of Canada and Newfoundland, Ottawa, p. 56, 1913 (off Canada in Atlantic).—Holt and Byrne, Fish. Ireland Sci. Invest. 1912, No. 1, p. 20. fig. 7a, 1913 (off Ireland).—Weber, Die Fische der Siboga Expedition, Leiden, vol. 57, p. 21, 1913 (Banda Sea, 2,798 meters).—Weber and Beaufort, The fishes of the Indo-Australian archipelago, vol. 2, p. 134, fig. 49, 1913 (Banda Sea).—Hoek, Conseil Perm. Intern. Expl. Mer. Pub. Circonst., No. 12, p. 53, 1914 (North Sea).—Jespersen, Report on the Danish oceanographical expeditions to the Mediterranean, 1908–1910, vol. 2, No. 3, pt. 2A, p. 23, 1915 (Atlantic).—Thompson, Mar. Biol. Rep. South Africa, No. 3, p. 72, 1916 (Cape Province).—Roule, Bull. Inst. Oceanogr. Monaco, No. 348, p. 4, 1918 (stomach contents tuna).—Roule, Resultats des campagnes scientifiques accomplies par le Prince Albert I, Monaco, fasc. 52, p. 25, 1919 (Atlantic).—Barnard, Ann. South African Mus., vol. 21, pt. 1, p. 153, 1925 (off Cape Point, South Africa, depth 460 fathoms).—Beebe, Zoologica, New York vol. 12, No. 1, p. 14, 1929 (Hudson Gorge, 1,000 fathoms).—Kyle and Ehrenbaum *in* Dunker, et al., Die Fische der Nord- und

Ostsee, p. X11f54, fig. 32, 1929 (North Sea).—Jordan, Evermann, and Clark, Report U.S. Comm. Fish, pt. 2, p. 74, 1930 (name only).—Norman, *Discovery* reports, vol. 2, p. 304, fig. 12, 1930 (Atlantic Ocean).—Jespersen *in* Joubin, Faune ichthyologique de l'Atlantique nord, No. 15, fig., 1934 (North Atlantic).—Rivero, Mem. Soc. Cubana Hist. Nat., vol. 8, No. 1, p. 31, 1934 (off Cuba).—Fowler, Bull. Amer. Mus. Nat. Hist., vol. 70, pt. 1, p. 243, fig. 114, pt. 2, p. 1207, 1936 (after Weber and Beaufort).—Howell-Rivero, Proc. Boston Soc. Nat. Hist., vol. 41, No. 4, p. 56, 1936 (Cuba).—Parr, Bull. Bingham Oceanogr. Coll., vol. 3, art. 7, p. 50, fig. 18, 1937.—Schultz, Smithsonian Misc. Coll., vol. 91, No. 27, p. 4, 1937 (detailed measurements); Proc. U.S. Nat. Mus., vol. 86, p. 152, 1938 (western North Atlantic).—Bertin, Bull. Mus. Nat. Hist. Nat. Paris, vol. 12, No. 6, p. 313, 1940 (holotype of *Sternoptyx olfersi* Cuvier from Cape Good Hope).—Fowler, Proc. Amer. Philos. Soc., vol. 82, No. 5, p. 749, 1940 (lat. 33°40′ N., long. 62°10′ W. from drawing).—Nybelin, Fauna och flora, Upsala, vol. 5, pp. 206–209, fig., 1947 (off Sweden).—Rey, Mem. Real Acad. Cien. Nat. Madrid, vol. 11, p. 252, figs. 81b, 83, 1947 (Atlantic).—Noronha and Sarmento, Vertebrados da Madeira, ed. 2, Peixes, vol. 2, pp. 114, 141, 1948 (Madeira).—Nybelin, Göteborgs Vet. Vitterh. Handl., ser. B, vol. 5, No. 16, p. 24, 1948 (eastern North Atlantic).—Bertelsen and Grøntved, Vid. Medd. Dansk Naturh. For., vol. 111, pp. 164–167, figs. 1–2, 1949 (photographed photophores from their own light from lat. 52°20′ N., long. 27°30′ W.).—Maul, Lísta sistemática dos peixes assinalados nos mares da Madeira e índice alphabetica, p. 13, 1949 (Madeira).—Smith, The sea fishes of southern Africa, p. 107, 1949 (off the "Cape" in 500 fathoms).—Holgersen, Stavenger Mus. Årbok 1949, vol. 59, p. 87, fig., 1950 (off Norway).—Harvey, Bioluminescence, New York, p. 550, fig. 186, 1952.—Koumans, Biological results of the *Snellius* expedition, pt. 16, p. 186, 1953 (East Indies).—Koumans, Temminckia, Leiden, vol. 9, p. 186, 1953 (Central Pacific).—Marshall, Aspects of deep sea biology, New York, p. 278, fig. XI, 6, 1954.

Study material: USNM 164295, South of Iceland, collected by Schaeffer and Starr, 1 specimen, 43 mm. MCZ 34981, *Atlantis* station 1021, August 1, 1931, lat. 42°56′ N., long. 30°19′ W., haul B16, depth tub. 4, 1 specimen, 70 mm.. MCZ 34991, *Atlantis* station 1021, August 1, 1931, lat. 42°56′ N., long. 30°19 W., haul B14, depth tub. 2, 3 specimens, 28 to 50 mm. MCZ 34992, *Atlantis* station 1008, July 28, 1931, lat. 49°33′ N., long. 30° W., haul B4, 2 specimens, 28 to 30 mm. MCZ 34951, *Atlantis* station 1011, July 29 to August 1, 1931, lat. 48°10′ N., long. 30°03′ W., 2 specimens, 34 and 37 mm. MCZ 35002, *Atlantis* station 1011, July 29, 1931, lat. 48°10′ N., long. 30°03′W., haul B7, depth tub. 3, 1 specimen, 36 mm. MCZ 31634, *Iselin* station 322, 1928, lat. 33° N., long. 64° W., 1 specimen, 36 mm.

Distinctive characters: Lower preopercular spine directed downward and curved forward and outward; upper preopercular spine short, directed outward, not extending past rear edge preopercular bone; 2 postabdominal spines, the anterior one hooked anteroventrally, the rear spine usually shorter and directed posteroventrally, the angle between them about 60°; space between anal group and subcaudal group of photophores rather narrow, about equal to width of last 2½

to 3 anal photophores; supra-abdominal photophores not in line with preanal and anal groups; ventral line of abdominal keel usually with a concave notch just in front of anterior postabdominal spine.

Description: Counts made are given in table 1, p. 591, and table 2, p. 592, the measurements made are given in table 3, p. 593. Greatest depth of pigmented part of body 1.2 to 1.4 and height of dorsal blade 7.5 to 9.5 times, both in postorbital length of body.

Range: This species is distributed in the Atlantic, Pacific, and Indian Oceans and occurs at depths of 1,000 fathoms (Beebe, 1929) and as far north in the Atlantic as lat. 52°20′ N., (Bertelsen and Grøntved, 1949).

Argyropelecus lynchus lynchus Garman

Figure 11

Argyropelecus lynchus Garman, Mem. Mus. Comp. Zool, vol. 24, p. 234, pl. J, figs. 1, 1b, 1899 (type locality, East Pacific, Panama Bay; lectotype USNM 57885).—Ledenfeld, Mem. Mus. Comp. Zool., vol. 30, No. 2, p. 170, pl. 6, figs. 24, 25, 1905 (anatomy light organs).—Vanderbilt, To Galápagos on the *Ara*, p. 132, pl. 5 (in color), 1927 (off Panama in Pacific, 300 fathoms).—Parr, Bull. Bingham Oceanogr. Coll., vol. 2, art. 4, p. 17, fig. 5, 1931 (Atlantic).

Argyropelecus sladeni, Norman, *Discovery* reports, vol. 2, p. 305, fig. 13, 1930 (Atlantic Ocean).—Jordan, Evermann and Clark, Report U.S. Comm. Fish 1928, pt. 2, p. 74, 1930 (name only).—Beebe, Bull. Inst. Oceanogr. Monaco, No. 629, p. 4, 1933 (off Bermuda, 200 to 400 fathoms).—Fowler, Bull. Amer. Mus. Nat. Hist., vol. 70, pt. 2, p.1207, 1936 (after Norman).—Parr, Bull. Bingham Oceanogr. Coll., vol. 3, art. 7, pp. 46–51, figs. 18–20, 1937 (no locality given).—Schultz (in part), Proc. U.S. Nat. Mus., vol. 86, p. 153, 1938 (East Pacific).—Marr, Copeia, No. 2, p. 140, 1948 (lat. 32°12′ N., long. 118°37′ W., depth 190 to 210 meters).

Argyropelecus lichnus Ulrey, Journ. Pan.-Pacific Res. Inst., vol. 4, No. 4, p. 3, 1929 (error for *lynchus;* off California).—Terron, Ann. Inst. Biol. Univ. Nac. Mexico, p. 76, 1932 (on Ulrey).

Argyropelecus d'urvillei, Bertin, Bull. Mus. Nat. Hist. Nat. Paris, vol. 12, No. 6, p. 314, 1940 (holotype *A. d'urvillei* Cuvier and Valenciennes, from Atlantic).

Argyropelacus lynchnus (misspelled), Nichols and Murphy, Bull. Amer. Mus. Nat. Hist., vol. 83, p. 235, 1944 (lat. 4°01′ N., long. 80°26′ W.).

Argyropelecus olfersi, Clemens and Wilby, Fishes of the Pacific Coast of Canada, Fish. Res. Board Canada, Bull, No. 67, p. 106, fig. 54, 1949 (British Columbia).

Study material: The following type specimens were examined: USNM 57885, lectotype, *Albatross* station 3360, lat. 6°17′ N., long. 82°5′ W., depth 1,672 fathoms, standard length 46 mm. USNM 120239, paratype, *Albatross* station 3410, lat. 0°19′ N., long. 90°34′ W., depth 331 fathoms, standard length 21 mm. USNM 120240, paratype, *Albatross* station 3383, lat. 7°21′ N., long. 79°2′ W., depth 1,832 fathoms, standard length 30 mm. USNM 120241, paratype, *Albatross* station 3395, lat. 7°30′36″ N., long. 78°39′ W., 730 fathoms, 32 mm. USNM 170966, paratype, *Albatross* station 3392, lat. 7°5′30″

N., long. 79°40′ W., depth 1,270 fathoms, standard length 26 mm. MCZ 28528, paratype, *Albatross* station 3414, lat. 10°14′ N., long. 96°28′ W., depth 2,232 fathoms (but a note in jar states "surface to 200 fathoms"), 3 specimens, 40 to 47 mm. MCZ 35193, paratype, *Albatross* hydrographic station 2619, lat. 7°31′00″ N., long. 78°42′ 30″ W., note in jar states "surface to 300 fathoms," 1 specimen, 19 mm. MCZ 35147, paratype, data same as MCZ 35193, 1 specimen, 26 mm.

Besides the types, the following lots were studied (the numbers of specimens are given in parentheses): USNM 148232(5), 150259(2), 164295(1). MCZ 34948(4). SIO H52–419(7) and S10–54–96(1). WHOI RHB569(2), RHB475(1). BOC 2708(4), 3006(1), *Atlantis* station 1355(6); also uncatalogued at BOC are five lots from off Peru, totaling 46 specimens.

Distinctive characters: Lower preopercular spine directed downward and sometimes curved a little forward; upper preopercular spine rather long, curved outward and sometimes upward, notably rather long and reaching past rear of bony edge of preopercle; 2 postabdominal spines, directed ventrally, anterior one curved or hooked forward or directed straight downward, the angle between these spines varying from 50° to 70°; preanal, anal, and subcaudal groups of photophores compact, the distance between anal and subcaudal groups less than width of last 2 anal photophores; length of exposed part of longest spine of dorsal blade 1.0 to 2.2 times in base of soft dorsal fin.

The *lynchus* complex of subspecies (*lynchus*, *sladeni*, and *hawaiensis*) differs from *olfersi* mostly in the upper preopercular spine, which is short and stubby and does not extend past the bony preopercular edge in *olfersi*, whereas in the *lynchus* complex the spine is long, hooked outward, sometimes a little dorsally, and reaches past the bony preopercular edge.

Although I am recognizing three subspecies of *lynchus* in the Indo-Pacific, I do so with some uncertainty. The character of the height of dorsal blade may not be a sound one, as it appears to become proportionately shorter on large specimens than on small ones of the same subspecies. Unfortunately, I lack enough specimens of *hawaiensis* for a fuller study of this problem.

The *lynchus-sladeni* populations also need a detailed study, but the number of specimens available to me are not sufficient for an analysis of variability.

Data indicate that three subspecies might be recognized on the basis of number of gill rakers (see table 4, p. 614) and height of dorsal blade. These are *lynchus lynchus* of the Eastern Pacific and Atlantic Oceans, *lynchus hawaiensis* of the Central Pacific, and *lynchus sladeni* of the Western Pacific and Indian Oceans. However, the problem of where these so-called subspecies meet in the areas where

TABLE 4.—*Number of gill rakers on first gill arch*

Subspecies and localities	Above angle			Below angle				Total rakers					
	8	9	10	9	10	11	12	17	18	19	20	21	22
lynchus lynchus													
East Pacific	27	1	—	2	23	3	—	2	22	4	—	—	—
West Atlantic	6	—	—	—	6	—	—	—	6	—	—	—	—
South Atlantic	4	—	—	—	2	2	—	—	2	2	—	—	—
lynchus sladeni													
Indian Ocean and West Pacific	1	5	1	—	1	5	1	—	—	2	4	—	1
lynchus hawaiensis	6	1	1	—	—	4	4	—	—	3	4	1	—

I have not seen specimens is unsolved, and all subspecies of the *lynchus* complex of populations may disappear into groups of more or less overlapping populations.

Although the height of the dorsal blade varies considerably from specimen to specimen of *lynchus lynchus*, six measured from the Western Atlantic had a shorter blade (1.8 to 2.2 times in base of soft dorsal) than those from the Eastern Pacific and South Atlantic (1.1 to 1.9 times in base of soft dorsal), but other differences were not observed.

DESCRIPTION: Counts made are given in table 1, p. 591, and table 2, p. 592; measurements made are given in table 3, p. 593.

RANGE: This subspecies occurs in the Eastern Pacific and Atlantic Ocean. I have studied material from: Pacific: Off Panama, 10 specimens; Galápagos, 9 specimens; off Northern Peru, 49 specimens; off Cocos Island, 5 specimens; off Clipperton Island, 7 specimens; off Costa Rica, 3 specimens. Atlantic: Off Delaware, 1 specimen; Iceland, 1 specimen; Bahamas, 1 specimen; Caribbean Sea, 6 specimens; Azores, 4 specimens; northwest of Cape Verde Islands, 1 specimen.

Depths range down to 2,222 fathoms (USNM 150259).

Argyropelecus lynchus sladeni Regan

Argyropelecus sladeni Regan, Trans. Linn. Soc. Zool., vol. 12, p 218, 1908 (type locality, Chagos Archipelago, Indian Ocean, depth 400 to 500 fathoms).—Jespersen *in* Joubin, Faune ichthyologique de l'Atlantique nord., No 15, figs., 1934 (? North Atlantic).—Schultz, Smithsonian Misc. Coll., vol. 91, No. 27, p. 4, 1937 (detailed measurements); (in part) Proc. U.S. Nat. Mus., vol. 86, p. 153, 1938 (Philippine Islands).—Norman, John Murray Expedition, 1933–34, Scientific reports, vol. 7, No. 1, p. 20, 1939 (Indian Ocean, depth 200 to 2,926 meters).—Fowler, Fishes of the Red Sea and southern Arabia, Jerusalem, vol. 1, p. 86, 1956 (Red Sea).

STUDY MATERIAL: USNM 103015, *Albatross* station 5368, lat. 13°35′30″ N., long, 121°48′ E., depth 181 fathoms, February 23,

1909, 2 specimens, 27 and 34 mm. USNM 103016, *Albatross* station 5387, lat. 12°54′40″ N., long. 123°20′30″ E., depth 209 fathoms, March 11, 1909, 1 specimen, 27 mm. USNM 103017, *Albatross* station 5447, lat. 13°28′ N., long. 123°46′18″ E., depth 310 fathoms, June 4, 1909, 1 specimen in bad condition. USNM 103018, *Albatross* station 5497, lat. 9°7′15″ N., long. 124°59′30″ E., depth 960 fathoms, August 3, 1909, 4 specimens, 14 to 19 mm. USNM 103020, *Albatross* station 5525, lat. 9°12′30″ N., long. 123°44′7″ E., depth 805 fathoms, August 11, 1909, 1 specimen, 35 mm. USNM 103021, *Albatross* station 5530, lat. 9°26′45″ N., long. 123°38′30″ E., no depth given, August 11, 1909, 1 specimen in poor condition. USNM 102787, *Albatross* station 4913, lat. 31°39′10″ N., long. 129°22′30′ E., depth 391 fathoms, August 12, 1906, 1 specimen, 39 mm., off Japan.

Distinctive characters: See *A. lynchus lynchus* and the discussion concerning the *lynchus* complex on p. 613.

Description: Counts made are given in table 1, p. 591, and table 2, p. 592; the measurements made are given in table 3, p. 593.

Range: This subspecies occurs in the Western Pacific and Indian Ocean. I have seen 10 specimens from the Philippines and 1 from off southern Japan.

Argyropelecus lynchus hawaiensis, new subspecies

Figure 12

Argyropelecus sladeni, Haig, Pacific Sci., vol. 9, p. 322, 1955 (off Mauna Loa lava flow, Hawaii).

Holotype: USNM 177931, Mauna Loa lava flow, Kona, Hawaii, June 6, 1950, Y. Yamaguchi, standard length 58 mm.

Paratypes: USNM 164003, same data as holotype, 2 specimens, standard lengths 55.5 and 60 mm. USNM 164001, Mauna Loa lava flow, Kona, Hawaii, June 2, 1950, Hayes and Burke, 1 specimen, standard length 62.3 mm. SIO H53–372, North Pacific Ocean, lat. 36°58′ N., long. 164°30′ E., November 4, 1953, 1 specimen, standard length 52 mm.

The University of Hawaii has 3 paratypes (no catalog numbers) taken with the holotype and bearing the same data, standard lengths 46 to 61.5 mm.

Description: Four specimens were measured in detail and these data, expressed in thousandths of the standard length, are recorded, respectively, for the holotype then the paratypes. Standard lengths in mm. are 58, 55.5, 60, and 62.3. Greatest depth of pigmented area of body 598, 612, 584, and 594; least depth caudal peduncle 103, 112, 115, and 108; greatest height of dorsal blade above pigmented part of body 46, 43, 33, and 35; postorbital length of body 831, 824, 800, and

856. Length of groups of photophores: Anal 176, 180, 183, and 178; preanal 121, 115, 113, and 117; subcaudal 86, 85, 83, and 83. Distance between preanal and anal groups of photophores 26, 27, 23, and 27; distance between anal and subcaudal groups of photophores 48, 49, 50, and 53; distance from upper edge of last abdominal photophore to upper edge of first preanal photophore 164, 150, 158, and 159; distance from tip of snout to rear edge of maxillary 278, 272, 292, and 287; distance from orbit to base of upper preopercular spine 198, 195, 203, and 194; length of snout 86, 83, 92 and 91; diameter of eye 129, 112, 137, and 138. The counts made on the types are given in table 1, p. 591, and table 2, p. 592; measurements made are given in table 3, p. 593.

Color: The color pattern is shown in figure 12, p. 627.

Range: This subspecies is known from 7 specimens collected in the Hawaiian Islands and 1 from the North Pacific at lat. 36°58′ N., long. 164°30′ E.

Remarks: This subspecies differs from *lynchus* and *sladeni*, its closest relatives, as is indicated in the key on p. 597.

Genus *Sternoptyx* Hermann

Sternoptyx Hermann, Naturforscher, vol. 16, p. 33, 1781 (type species *Sternoptyx diaphana* Hermann).

The genus *Sternoptyx* has the following characters: Abdominal vertebrae 11; caudal vertebrae 17 to 20; branched caudal rays 9 + 8; pectoral rays 10 or 11; dorsal 9 to 11; anal 13 to 15; gill rakers on first gill arch 4 to 7 + 2 to 4 + 5 to 7 totaling 12 to 16.

The number of organs in groups of photophores are as follows: Abdominal 10, anal 3, branchiostegals 3, isthmus 5, preanal 3, preopercular 1, preorbital 1, postorbital 1, subcaudal 4, subopercular 1, supra-abdominal none, supra-anal 1, suprapectoral 3.

The dorsal blade consists of a single enlarged pterygiophore; there are no anal pterygiophores between the haemal spines on four of the abdominal vertebrae, usually numbers 5 to 8 or 6 to 9, the anal pterygiophores being displaced forward. Teeth on edge of maxillary directed outward; at origin of anal fin a pair of short spines, two pairs of short postabdominal spines in front of pelvic bases; a pair of preabdominal spines; preopercular spine single, directed downward; short spine at lower posterior angle of dentary; postemporal ending in a short spine; anterior edge of dorsal blade denticulate.

Although I have made numerous counts and measurements on specimens from the various seas, nothing could be found that indicated more than a single species for the world. Counts made are given in table 1, p. 591, and table 5, next page.

Table 5.—*Counts recorded for* Sternoptyx diaphana

Locality	Fin rays						Number of gill rakers on first arch														
	Anal			Dorsal			Upper arch				Lower arch						Total rakers				
											Normal			Rudimentary							
	13	14	15	9	10	11	4	5	6	7	2	3	4	5	6	7	12	13	14	15	16
Atlantic	1	14	10	—	14	8	13	8	—	—	1	20	—	—	11	10	—	9	7	7	—
West Pacific	3	10	—	6	7	—	10	2	—	—	—	10	2	3	9	—	2	7	3	—	—
East Pacific	2	14	1	1	14	2	3	4	5	2	2	9	2	—	11	3	1	1	1	7	4

Sternoptyx diaphana Hermann

Figure 2

Sternoptyx diaphana Hermann, Naturforscher, vol. 16, p. 33, 1781 (type locality, America, ? Jamaica).—Cuvier, The animal kingdom (Griffith's ed.), vol. 10, p. 435, 1834; Le règne animal (Diciple's ed.), vol. 4, p. 271, 1836–1849.—Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 22, p. 415, 1849 (Eastern Atlantic).—Günther, Catalogue fishes British Museum, vol. 5, p. 387, 1864 (Atlantic).—Goode and Bean, Bull. Mus. Com. Zool. vol. 10, No. 5, pp. 186, 189, 220, 1882 (Western Atlantic north to lat. 33°19′ N.).—Günther, Report of the scientific results of the voyage of H.M.S. *Challenger* during 1873–76, vol. 22, p. 169, pl. 45, fig. D, D′, 1887 (Atlantic and Pacific to a depth of ? 2,500 fathoms).—Jordan, Report U.S. Comm. Fish and Fisheries 1885, vol. 13, p. 833, 1887 (Atlantic).—Vaillant, Expéditions scientifiques du *Travailleur* et du *Talisman* pendant les années 1880–1883, Poissons, p. 102, 1888 (Coast of Maroc, Azores).—Lütken, Mem. Acad. Sci. Lett. Danemark, ser. 6, vol. 7, p. 283, 1892 (North Atlantic).—Collett, Resultats des campagnes scientifiques accomplies par le Prince Albert I, Monaco, vol. 10, p. 125, 1896 (Eastern Atlantic).—Gilbert, Report U.S. Comm. Fish. and Fisheries 1893, p. 465, 1896 (off California).—Jordan and Evermann, U.S. Nat. Mus. Bull. 47, pt. 1, p. 603, 1896 (Atlantic).—Gilbert and Cramer, Proc. U.S. Nat. Mus., vol. 19, p. 416, 1897 (Hawaiian Islands).—Alcock, A descriptive catalogue of the Indian deep-sea fishes in the Indian Museum . . ., Calcutta, p. 136, 1899 (off Malabar Coast in 912 to 931 fathoms).—Jordan and Snyder, Proc. U.S. Nat. Mus., vol. 23, p. 350, 1900 (off Hokkaido).—Jordan and Seale, Bull. U.S. Bur. Fish. 1905, vol. 25, p. 180, 1906 (Hawaii).—Brauer, Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dampfer *Valdivia*, 1898–1899 . . ., vol. 15, pt. 1, p. 115, figs. 56–63, 1906; pt. 2, p. 175, pl. 36, figs. 1–3, 1908 (Anatomy).—Richard, Bull.Inst. Oceanogr. Monaco, No. 162, p. 149, 1910 (from tuna stomach).—Zugmayer, Resultats des campagnes scientifiques accomplies par le Prince Albert I, Monaco, fasc. 35, p. 54, pl. 2, fig. 5, 1911 (North Atlantic).—Murry and Hjort, The depths of the ocean . . ., p. 612, 1912 (Atlantic.—Halkett, Checklist of

the fishes of the Dominion of Canada and Newfoundland, Ottawa, pp. 16, 56, 1913 (off Newfoundland).—Holt and Byrne, Fish. Ireland Sci. Invest., No. 1, p. 23, fig. 9, 1913 (off Ireland, depth 600–900 fathoms).—Jordan, Tanaka, and Snyder, Journ. College Sci. Imper. Univ. Tokyo, vol. 33, art. 1, p. 52, 1913 (off Hokkaido).—Weber, Die Fische der Siboga Expedition, Leiden, vol. 57, p. 22, 1913 (East Indies, depth 828 to 2,477 meters).—Hoek, Cons. Perm. Internat. Expl. Mer. Pub. Circonst., No. 12, p. 53, 1914 (North of Europe).—Pappenheim, Die Fische der Deutschen Südpolar-Expedition 1901–1903, vol. 15, pt. 2, p. 183, 1914 (South Atlantic to lat. 23°33′ S.).—Weber and de Beaufort, The fishes of the Indo-Australian archipelago, vol. 2, p. 132, fig. 48, 1914 (East Indies).—Jespersen, Report on the Danish oceanographical expeditions to the Mediterrenean, 1908–1910, vol. 2, p. 28, 1915 (Central North Atlantic to lat. 42° N.).—Roule, Resultats des campagnes scientifiques accomplies par le Prince Albert I, Monaco, vol. 52, p. 24, 1919 (Azores).—Vaillant, Resultats des campagnes scientifiques accomplies par le Prince Albert I, Monaco, vol. 52, pp. 129, 144, 147, 149, 155, 1919 (Eastern Atlantic).—Jordan and Jordan, Mem. Carnegie Mus., vol. 10, No. 1, p. 9, 1922 (Hawaiian Islands).—Barnard, Ann. South African Mus., vol. 21, p. 154, 1925 (off Cape Point, South Africa).—Fowler, Mem. Bernice Pauahl Bishop Mus., vol. 10, p. 35, 1928 (Hawaiian Islands).—Beebe, Zoologica, New York, vol. 12, No. 1, pp. 4, 14, 1929 (Hudson Gorge off New York).—Roule and Angel, Resultats des campagnes scientifiques accomplies par le Prince Albert I, Monaco, fasc. 79, p. 34, pl. 2, figs. 39–48, 1930 (larvae, adults, Eastern Atlantic).—Borodin, Bull. Mus. Comp. Zool., vol. 72, No. 3, p. 68, 1931 (Central North Atlantic).—Roule and Angel, Resultats des campagnes scientifiques accomplies par le Prince Albert I, Monaco, fasc. 86, p. 80, 1933 (Atlantic).—Beebe, Bull. Inst. Oceanogr. Monaco, No. 629, pp. 4, 13, 14, 1933 (off Bermuda).—Roxas, Philippine Journ. Sci., vol. 55, No. 3, p. 287, 1934 (Philippines).—Fowler, Bull. Amer. Mus. Nat. Hist., vol. 70, pt. 1, p. 241, fig. 113, pt. 2, p. 1207, 1936.—Beebe, Zoologica, New York, vol. 22, pt. 3, p. 202, 1937 (off Bermuda, depth zero to 1,000 fathoms).—Norman, British, Australian, and New Zealand Antarctic Research Expedition, 1929–1931, vol. 1, No. 2, p. 83, 1937 (South Pacific to lat. 41°59′ S.).—Parr, Bull. Bingham Oceangr. Coll., vol. 3, No. 7, p. 57, 1937 (Western Atlantic north to lat. 32°24′ N.).—Fowler, Acad. Nat. Sci. Philadelphia, monogr. 2, p. 265, 1938 (off Hawaiian Islands).—Norman, John Murray Expedition, 1933–34, Scientific reports, vol. 7, No. 1, p. 20, 1939 (Arabian Sea, Zanzibar, Maldives).—Longley and Hildebrand, Pap. Tortugas Lab. Carnegie Inst. Washington, vol. 34, No. 535, p. 16, 1941 (off Tortugas).—Rey, Mem. Real Acad. Cienc. Exact. Fis. Nat. Madrid, vol. 11, p. 242, fig. 80, 1947 (Atlantic).—Noronha and Sarmento, Vertebrados da Madeira, ed. 2, Peixes, vol. 2, p. 141, 1948 (Madeira).—Nybelin, Göteborgs Vet. Vitterh. Samh. Handl., ser. B, vol. 5, No. 16, p. 25, 1948 (Eastern North Atlantic).—Maul, Lísta sistemática dos peixes assinalados nos mares da Madeira e indice alphabetica, p. 13, 1949; Mus. Mun. Funchal, No. 4, art. 9, p. 17, fig. 4, 1949 (Madeira).—Wilimovsky, Copeia, No. 3, p. 247, 1951 (correct spelling of generic name).—Koumans, Temminckia, Leiden, vol. 9, p. 186, 1953 (East Indies).—Mead and Taylor, Journ. Fish. Res. Board Canada, vol. 10, No. 8, p. 570, fig. 5, 1953 (off Iwate Prefecture, Japan).—Haig, Pacific Sci., vol. 9, p. 319, 1955 (off Hawaii).—Fowler, Fishes of the Red Sea and southern Arabia, Jerusalem, vol. 1, p. 86, 1956 (Arabian Sea).—Guenther and Deckert, Creatures of the deep sea, New York, pp. 29, 119, fig. 9, 1956 (off Bermuda).—Grey, Fieldiana, Zool., vol. 39, No. 29, p. 326, 1959 (Gulf of Mexico).

Sternoptyx obscura Carman, Mem. Mus. Comp. Zool., vol. 24, p. 232, pl. 53, fig. 1, 1899 (type locality, Eastern Pacific, lat. 0°36′ S. to 7°31′ N., long. 78°42′30″ to 89°3′30″ W., from 134 to 1,832 fathoms, lectotype USNM 177888; lectoparatypes USNM 120294, 177889, and 177933).—Lendenfeld, Mem. Mus. Comp. Zool., vol. 30, No. 2, p. 175, pl. 6, figs. 26–27, 1905 (light organs).—Beebe, The *Arcturus* adventure, New York, p. 396, frontispiece, fig. B, 1926 (off Galápagos).—Belanski *in* Vanderbilt, To Galápagos on the *Ara*, p. 131, 1927 (off Panama in Pacific).—Borodin, Bull. Vanderbilt Oceanogr. Mar. Mus., vol. 1, art. 1, p. 11, 1928 (lat. 10°14′ N., long. 90° W., Eastern Pacific Ocean).—Follett, Proc. California Acad. Sci., vol. 27, No. 16, p. 409, 1952 (off Pt. Reyes, California).—Harvey, Bioluminescence, New York, pp. 540, 541, fig. 184 (1) 1952.

Study material: I have studied 1,229 specimens from the Eastern Pacific, 47 from the mid-Pacific, 14 from the Western Pacific, and 311 from the Western Atlantic. The largest specimen in the Atlantic measured was 46.5 mm from tip of snout to caudal fin base, taken at *Atlantis* station 2852, lat. 27°01′ N., long. 94°22′ W. at a depth of 1,152 meters. In the Pacific, one specimen (SIO55–249) taken at lat. 4°6′ N., long. 78°43′ W., at a depth from 0 to 730 fathoms, measured 42 mm.

Since so many specimens were studied, they are summarized below; the numbers of specimens are given in parentheses:

ANSP 71332(1).

BOC 2704(38), 2775(8), 2776(1), 2777(22), 2778(4), 2779(7), 2780(1), 2781(1), 2782(16), 2783(6), 2784(4), 2785(6), 2793(27), 2794(39); *Atlantis* stations (uncataloged) 1355(1), 1935(2), and 2852(2).

CNHM 45341(2), 45942(11), 46278(2), 59968–59970(3), 64349(1).

MCZ 25880, 2588A(2), 28122(1), 28124(1), 28533(4), 31632(2), 32294–32296(12), 35175(1), 35192(2), 37528(1), 37662(1), 38040(1), 38066(1), 39478(3), 39482(1); *Blake* station 306(1); *Atlantis* station 2947(6), 2996(1), 3308(1), 3473(1).

SIO 56–83(4), 57–43(3), 57–88(2), 55–221(60), 57–46(3), 57–207(5), 54–95(4), 55–246(58), 55–258(28), 54–123(3), 56–127(15), 56–133(22), 55–249(52), 54–83(2); H53–371(1), H52–309(1), H51–161(1), H53–307(1), H52–355(11), H51–399(5), H52–419(2), H51–397(2), H51–377(8), H53–356(1), H52–320(7), H50–277(4), H52–384(7), H52–82(1), H53–305A(2), H51–375(7), H51–161(4), H52–409(8), H52–404(4), H52–338(3).

SNHM 18476(8), 46437(9), 46526(2), 46528–46529(9), 46532(3), 46535–46541(183), 46543(6), 46549–46551(30), 46560(1), 46565–46568(35), 46570–46572(75), 46574–46578(51), 46580–46583(72), 46585–46586(17), 46588–46589(7), 46591–46592(12), 46594(3), 46596–46610(84), 46612(2), 46614(29), 46616(18), 46618(11), 46620(3), 46622(13), 46624(9), 46626(2), 46628(4), 46633–46639(49), 46643(129).

UMML 2484(1), 2750(3), 2752(1), 2753(1).

USFWS (Brunswick, Georgia) *Silver Bay* station 443(3); *Combat* station 290(1), 295–296(4), 301–303(21), 304–305(9), 312–313(12), 323–324(10).

USNM 26235(1), 32659(1), 33471(2), 33563(2), 44590(1), 53052(2), 57884(1), 84497(1), 89912(6), 100531(1), 103071(1), 103075(1), 104206(2), 104207(1), 117221(1), 120294(1), 131297(1), 131307(1), 135647(1), 135665(1), 135672(1), 135690(1), 148789(4), 148848(1), 150040(3), 150306(1), 150416(1), 150441(1), 151395(1), 158168(9), 161392(2), 161394–161396(3), 163492(1), 177888(1), 177889(1), 177933(1); *Albatross* station 2553(1), 3402(1), 4650(2); *Combat* sta-

tion 452(3); *Oregon* station 1073(2), 1168(4), 1273(2), 1370(11), 1440(3); *Pelican* station 53(1), 58(1).

Description: Counts made are given in table 1, p. 591, and table 5, p. 617.

Range: The species is commonly taken at depths of from 100 to 1,000 fathoms in the Pacific, Atlantic, and Indian Oceans, but many records exceed 1,000 fathoms. Of SIO numbers H53–371, taken at lat. 32°8′ N., long. 142°4′ E., over the Japan Trench, one specimen was taken between the surface and 4,455 fathoms; of SIO H53–307 taken at lat. 39°34′–23′ N., long. 142°29.5′–51′ W., one specimen was taken between 2,500 and 2,700 fathoms, the latter record being also the most northerly latitude for the species in the Pacific. In the Atlantic the deepest records are for *Oregon* station 1273 at 1,600 fathoms and *Albatross* station 2101 (USNM 33563) at 1,686 fathoms. The most northerly record for the Atlantic is MCZ 37662 taken at lat. 42°46′ N., long. 63°22′ W.

Genus *Polyipnus* Günther

Polyipnus Günther, Report of the scientific results of the voyage of H.M.S. *Challenger* during 1873–76, vol. 22, p. 170, 1887 (type species *Polyipnus spinosus* Günther).—Haneda, Pacific Sci., vol. 6, No. 1, pp. 13–16, 1952 (light organs).

Acanthopolyipnus Fowler, Proc. Acad. Nat. Sci. Philadelphia, vol. 85, p. 257, 1934 (type species *Polyipnus fraseri* Fowler).

Species referable to the genus *Polyipnus* have the following characters in common: Abdominal vertebrae 11; caudal vertebrae 21 to 25; branched caudal fin rays 9+8; pectoral rays ii,10–ii,15; dorsal rays 11 to 17; anal rays 13 to 19; gill rakers on first gill arch 4 to 10+6 to 18.

The number of organs in groups of photophores are as follows: Abdominal 10, anal 4 to 17, branchiostegal 6, isthmus 6, lateral 1, preanal 5, preopercular 1, preorbital 1, postorbital 1, subcaudal 4, subopercular 1, supra-anal 3 when present, supra-abdominal 3, suprapectoral 3. For the location of the groups of photophores see figure 1, p. 588.

Premaxillary and maxillary finely denticulate teeth pointing outward and backward; dentition in both jaws in two or three rows; dorsal blade represented by a pair of small diverging bony keels ending in spines at front base of dorsal fin; posttemporal with one or more spines projecting posteriorly, and dorsal ridge of posttemporal may bear spines; bony preopercular edge may be spiny and a long or short spine occurs at posteroventral corner of preopercle; ventral edge of abdomen may be denticulate. In adults spiny ridges may develop around anal region and on ventral edge of caudal peduncle; a pair of diverging spines at pelvic bases; pectoral shield usually with ventral edge denticulate; teeth present on vomer and present or absent on

palatines; the dorsal blade is reduced in this genus to five or six dorsal pterygiophores, the last one, just in front of dorsal fin base, projects as a paired spine. These pterygiophores are not fused into a projecting plate in this genus.

The various species of *Polyipnus* may be distinguished on the basis of counts of fin rays, gill rakers, and vertebrae and distribution and location of groups of photophores. Especially important are the posttemporal and preopercular spines, which have unique shapes and lengths for nearly every species in the genus.

Counts made for available species of *Polyipnus* are given in table 1, p. 591, and table 6, p. 636; measurements made are given in table 7, p. 638. An examination of the frequency distributions of the various counts indicate significant differences in numbers of vertebrae, gill rakers, and fin rays.

Four new species of *Polyipnus* are described as a result of borrowing specimens, one each from the Eastern Atlantic and Indian Oceans and two from Japan. By means of the key below, all known species of *Polyipnus* may be distinguished.

A. Fraser-Brunner (Ann. Mag. Nat. Hist., vol. 8, ser. 10, p. 218, 1931) recorded *Polyipnus laternatus* from the Atlantic, but he was not able to locate the three specimens on which he based his identification. They are probably actually *P. polli* (see p. 635).

Key to the Species of *Polyipnus*

1a. At anterior end of anal series of photophores occur three supraanal photophores located much above general line of anal organs; minute teeth present on vomer and palatines; posttemporal spine simple, smooth, and shorter than diameter of pupil.

2a. Anal photophores 6 or 7; total dorsal rays 15. (Eastern Atlantic Ocean.) . . . . **polli**, new species

2b. Anal photophores 8 to 13.

3a. Anal photophores 10 to 13, rarely 10; posttemporal spine equal in length to width of last 4 to 7 anal photophores. (Western Atlantic Ocean.) . . . . **laternatus** Garman

3b. Anal photophores 8 to 10.

4a. Gill rakers on lower part of first arch 9 to 12, and total rakers 14 to 19; anal photophores 8 or 9; dorsal rays 11 or 12; anal rays 17 to 19. (Philippine Islands in the Pacific Ocean.). **triphanos** Schultz

4b. Gill rakers total 19 to 24.

5a. Dorsal rays 14 to 17; a broad wedge-shaped dark bar anterodorsally on body does not reach ventrally to midlengthwise axis of body; no white bar behind dark bar. (Western Atlantic Ocean and the Gulf of Mexico.) . . . . **asteroides** Schultz

5b. Dorsal rays 12 or 13; a narrow wedge-shaped dark bar anterodorsally on body (behind head) that reaches to midlengthwise axis of body; a narrow white bar behind dark bar that reaches to middorsal line. (Japan, in the Western Pacific Ocean.)
matsubarai, new species

1b. At anterior end of anal series of photophores, no light organ is located high above the general line of other organs as in 1a.; minute teeth present on vomer but absent on palatines.

6a. Anal photophores four.

7a. Posttemporal spine, long, strong and with two strong spines basally; posterior bony edges of both supracleithrum and preopercle serrated. (Philippine Islands, in the Pacific Ocean.) . . . . **fraseri** Fowler

7b. Posttemporal spine, simple and very short; posterior bony edges of supracleithrum and preopercle smooth. (Japan, in the Pacific Ocean.) . . . . **japonicus,** new species

6b. Anal photophores 10 to 17.

8a. Gill rakers on first arch 4 or 5 + 6 to 8 totaling 10 to 12; posttemporal spine, long, slender, simple, its length greater than diameter of pupil; greatest depth of body about twice in standard length; space between anal and subcaudal groups of photophores shorter than width of 3 subcaudal organs. (Philippine Islands, in the Pacific Ocean.) . . . . **unispinus** Schultz

8b. Number of gill rakers on first gill arch 6 to 10 + 12 to 18 totaling 18 to 28.

9a. Posttemporal spine very short, strong, its length shorter than diameter of pupil.

10a. Number of gill rakers on first arch total 21 to 24; width of subcaudal group of photophores into the distance between anal and subcaudal groups 1.0 to 1.5 times. (Hawaiian Islands, in the Pacific Ocean.) . . . . . **nuttingi** Gilbert

10b. Number of gill rakers on first arch total 20; width of subcaudal group of photophores into the distance between anal and subcaudal groups 0.6 to 0.8 times. (Western Indian Ocean.) . . . . **indicus,** new species

9b. Posttemporal spine long, slender, with one or two curved basal spines, the dorsal one the longest, always longer than diameter of pupil.

11a. Anal photophores 13 to 17, rarely 13; anal rays 15 to 18; pectoral rays 12 to 15; length of posttemporal spine 5.0 to 6.9 times in greatest depth of body; number of caudal vertebrae usually 24, occasionally 23 and 25; caudal peduncle long and slender. (Western Pacific and Indian Oceans.) . . . . **tridentifer** McCulloch

11b. Anal photophores 12 to 14, rarely 14; anal rays 14 to 17; pectoral rays 13 to 16; length of posttemporal spine 7.0 to 16.0 times in greatest depth of body; caudal vertebrae usually 23, occasionally 22 and 24; caudal peduncle short and deep. . . . . **spinosus** Günther

12a. Total gill rakers on first arch 18 to 20. (Philippine Islands and Celebes Sea, Pacific Ocean.)
spinosus spinosus Günther

12b. Total gill rakers on first arch 22 to 28. (Japan, in the Pacific Ocean.) . **spinosus sterope** Jordan and Starks

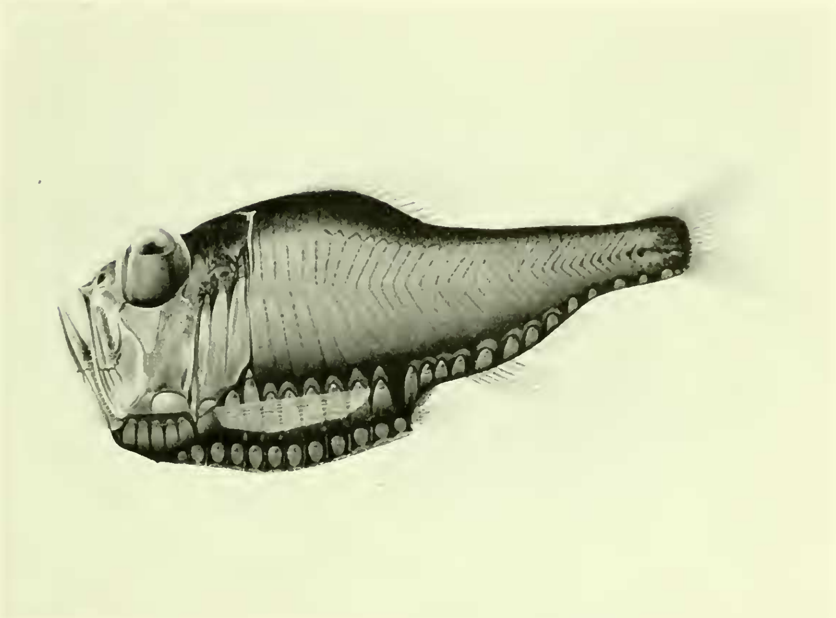


FIGURE 3.—*Argyropelecus affinis* Garman. After Brauer, 1906.

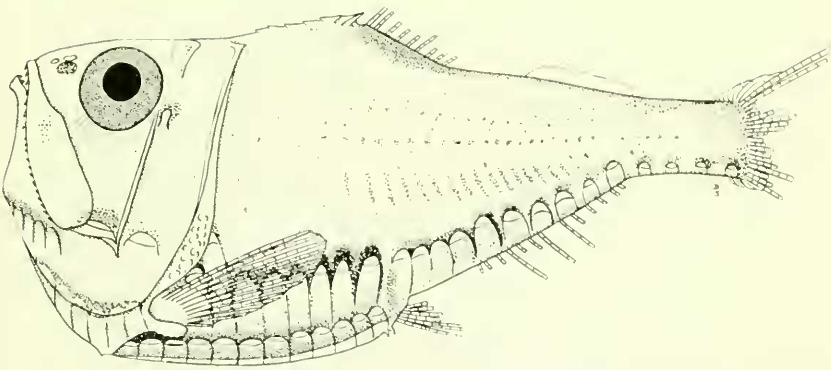


FIGURE 4.—*Argyropelecus pacificus*, new species. Holotype USNM 164000. Drawn by Dorothea B. Schultz.

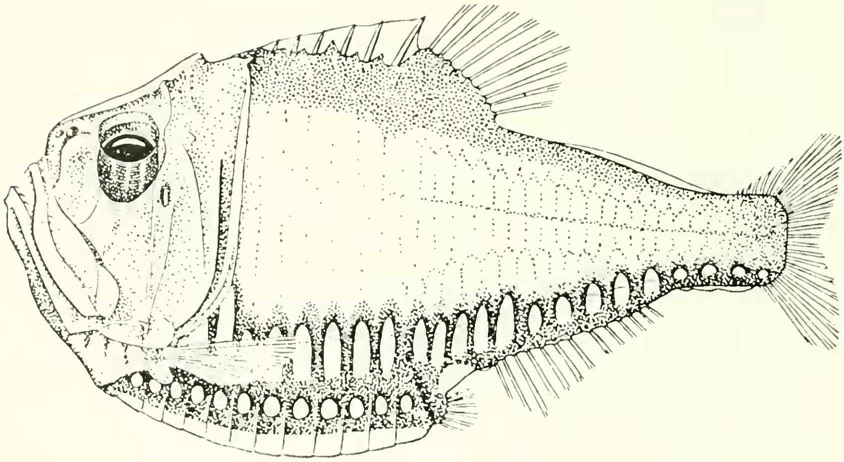


Figure 5.—*Argyropelecus gigas* Norman. After Norman, 1930.



Figure 6.—*Argyropelecus hemigymnus* Cocco. Drawn by Craig Phillips.

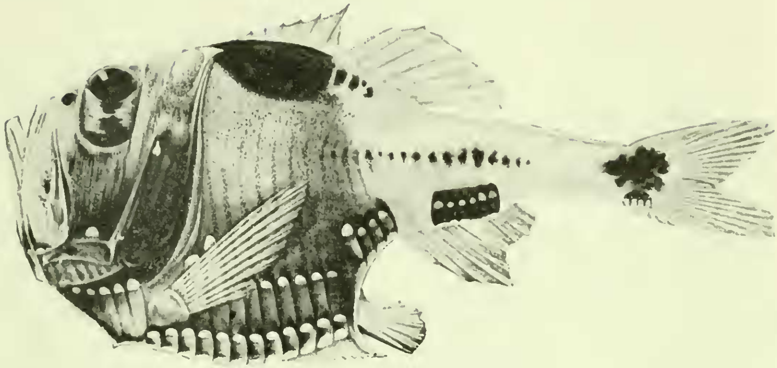


FIGURE 7.—*Argyropelecus intermedius* Clarke. After Gilbert, 1905, pl. 72.

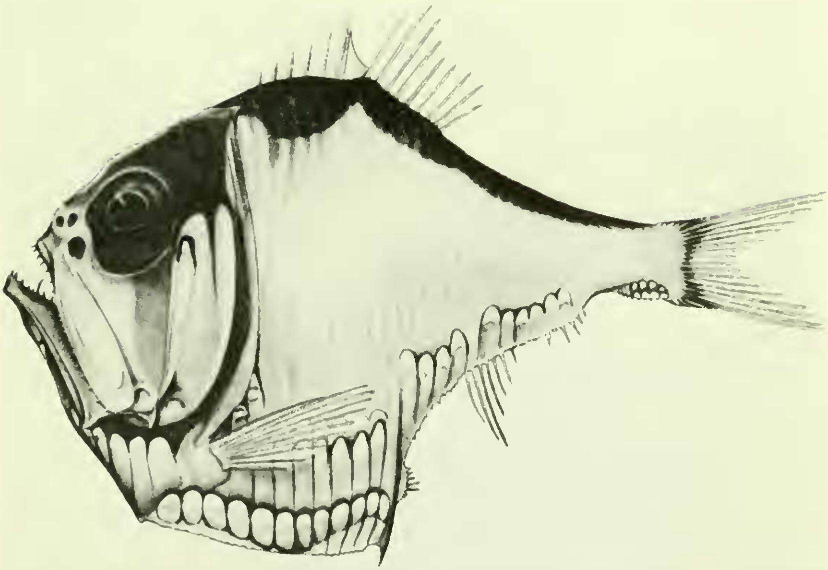


FIGURE 8.—*Argyropelecus amabilis* (Ogilby). After McCulloch, 1923.

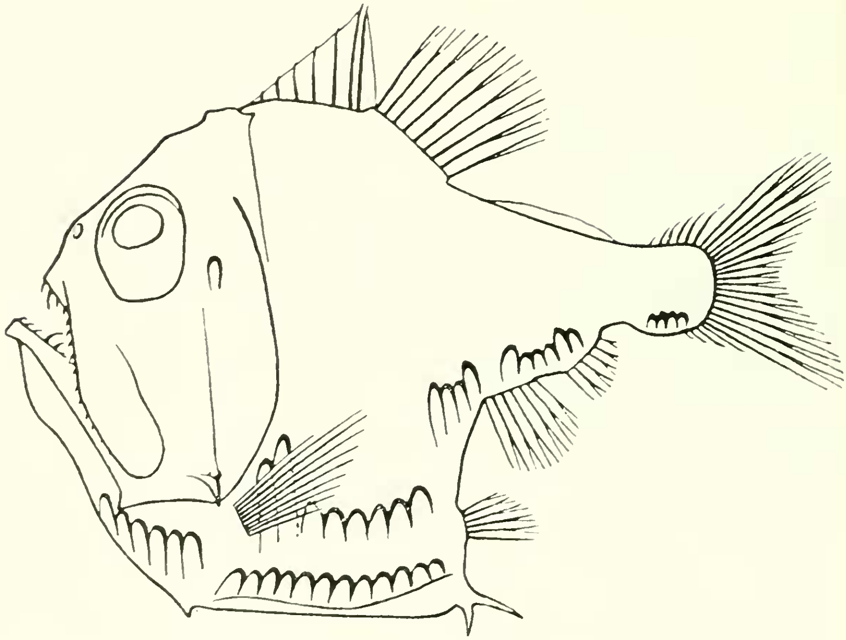


FIGURE 9.—*Argyropelecus aculeatus* Cuvier and Valenciennes. After Norman, 1930.

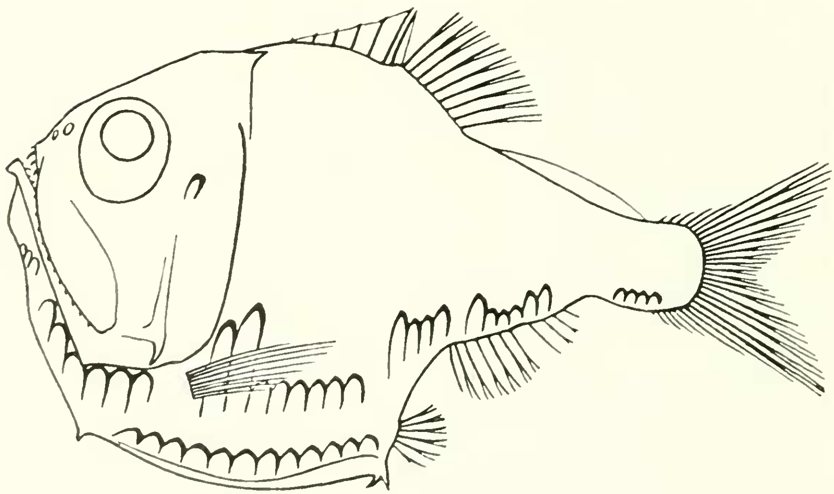


FIGURE 10.—*Argyropelecus olfersi* Cuvier. After Norman, 1930.

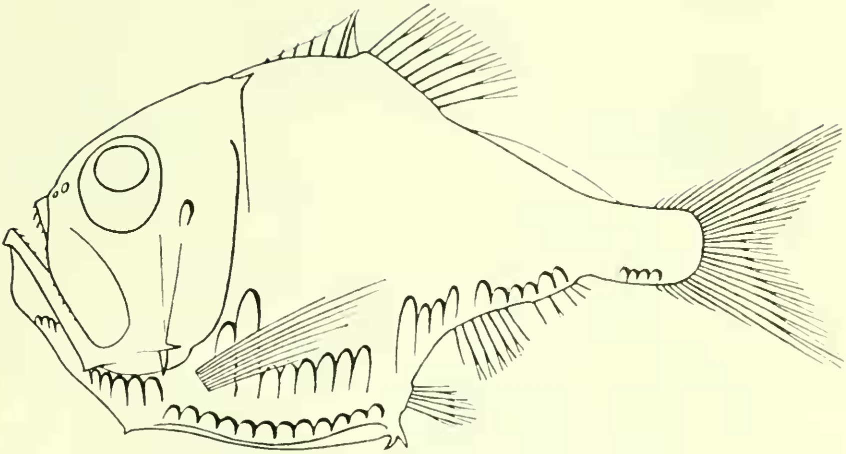


FIGURE 11.—*Argyropelecus lynchus lynchus* Garman. After Norman, 1930.

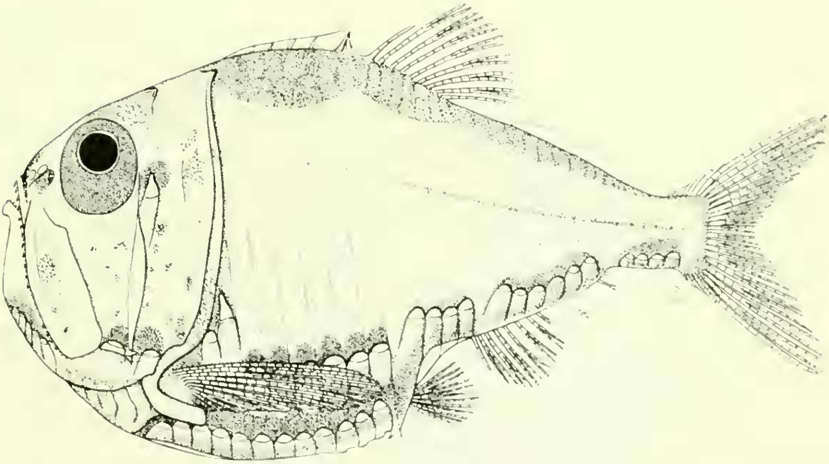


FIGURE 12.—*Argyropelecus lynchus hawaiensis*, new subspecies. Holotype USNM 177931. Drawn by Dorothea B. Schultz.

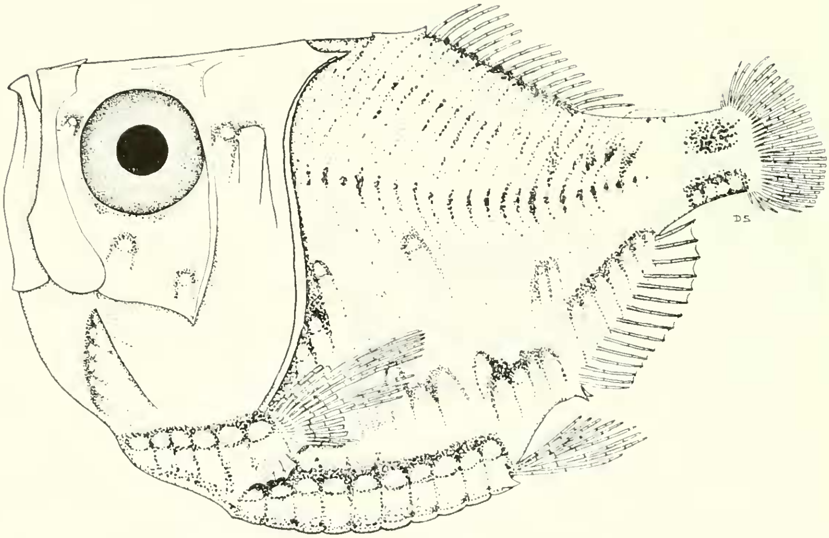


FIGURE 13.—*Polyipnus polli*, new species. Holotype KMMA 95092. Drawn by Dorothea B. Schultz.

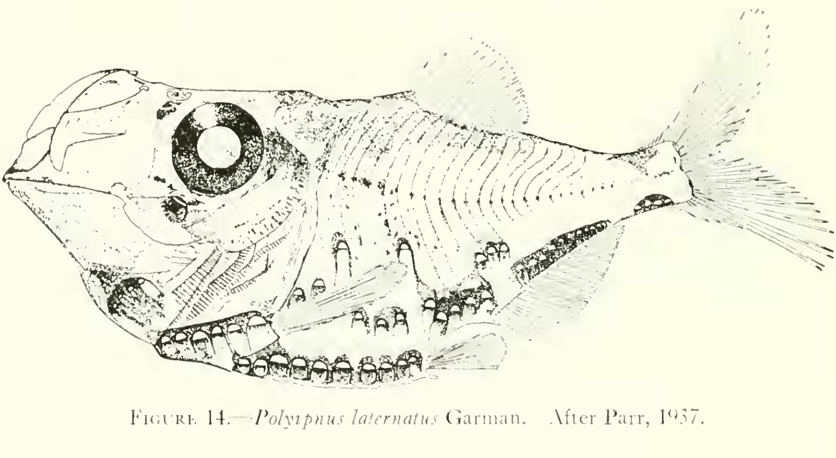


FIGURE 14.—*Polyipnus laternatus* Garman. After Parr, 1937.

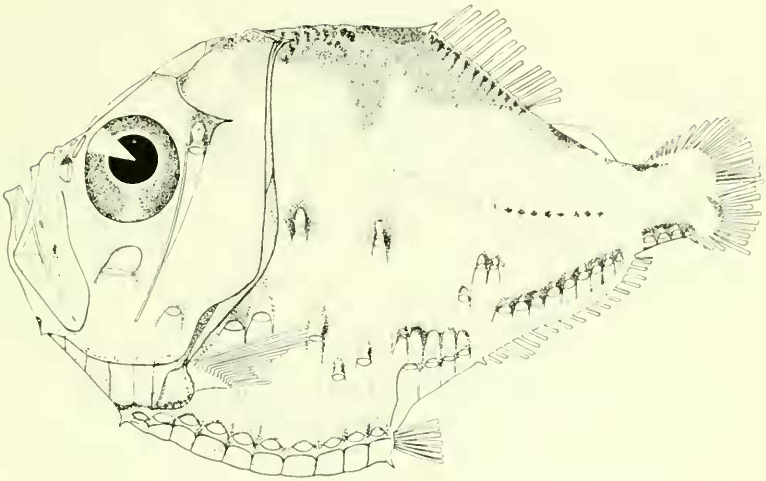


Figure 15.—*Polyipnus triphanos* Schultz. After Schultz, 1938.

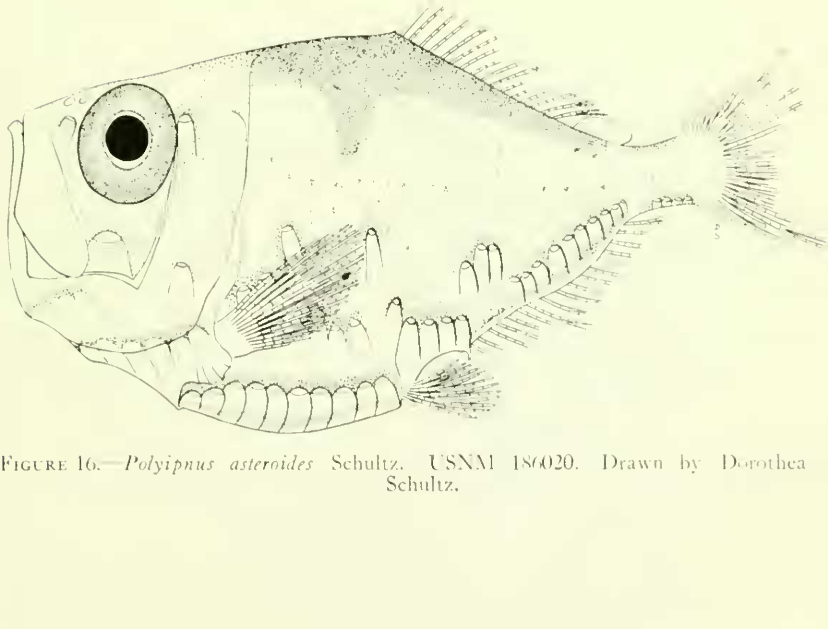


Figure 16.—*Polyipnus asteroides* Schultz. USNM 186020. Drawn by Dorothea B. Schultz.

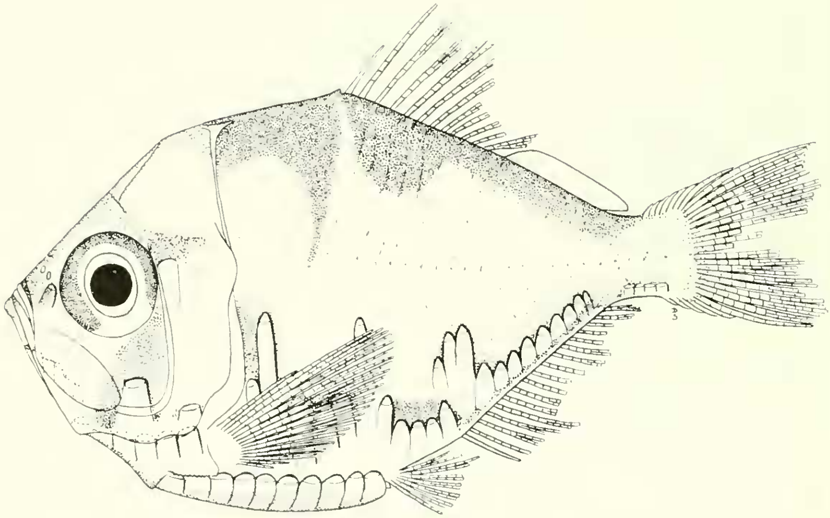


FIGURE 17.—*Polyipnus matsubarai*, new species. Holotype, USNM 179793. Drawn by Dorothea B. Schultz.

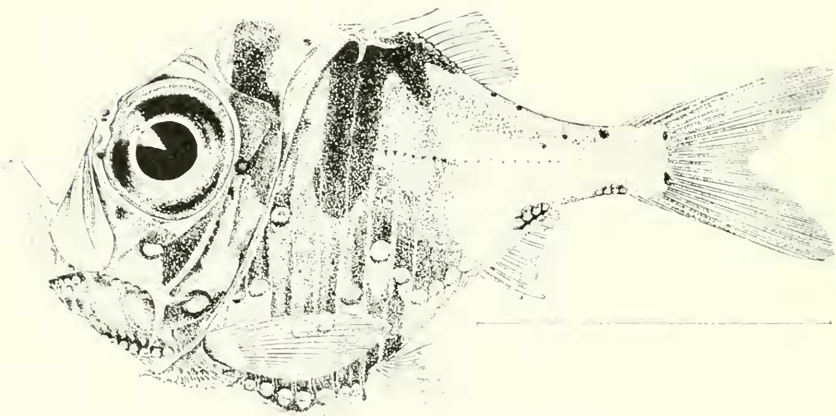


FIGURE 18.—*Polyipnus fraseri* Fowler. Retouched from holotype USNM 92324 by Dorothea B. Schultz.

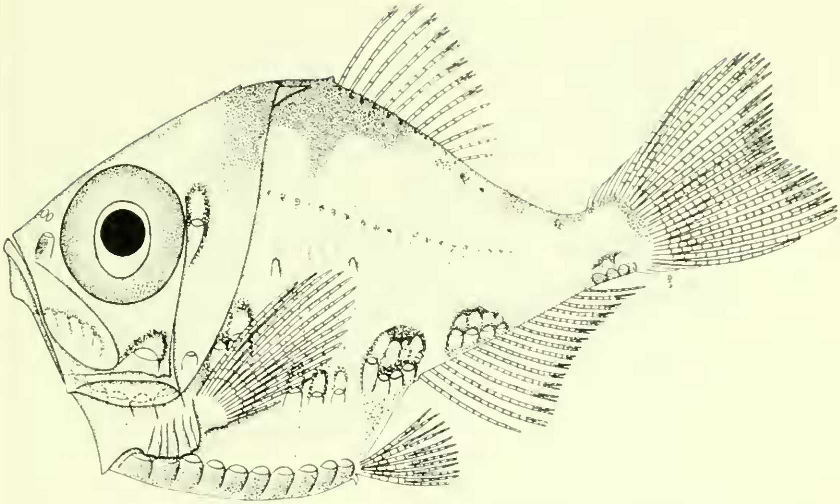


FIGURE 19.—*Polyipnus japonicus*, new species. Holotype, SIO H53-367. Drawn by Dorothea B. Schultz.

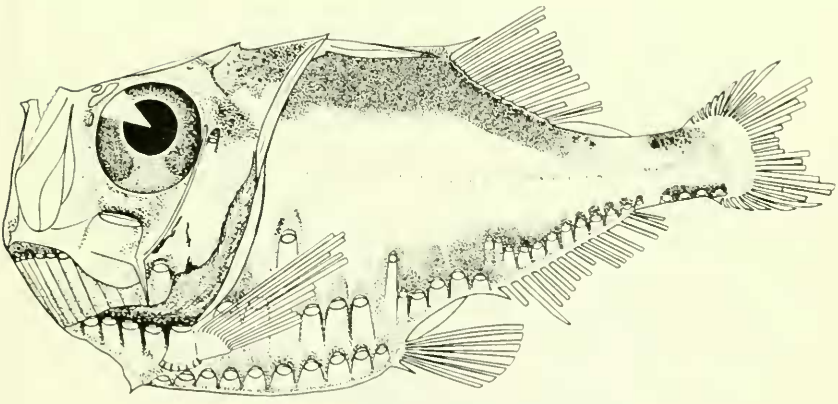


FIGURE 20.—*Polyipnus unispinus* Schultz. After Schultz, 1938.

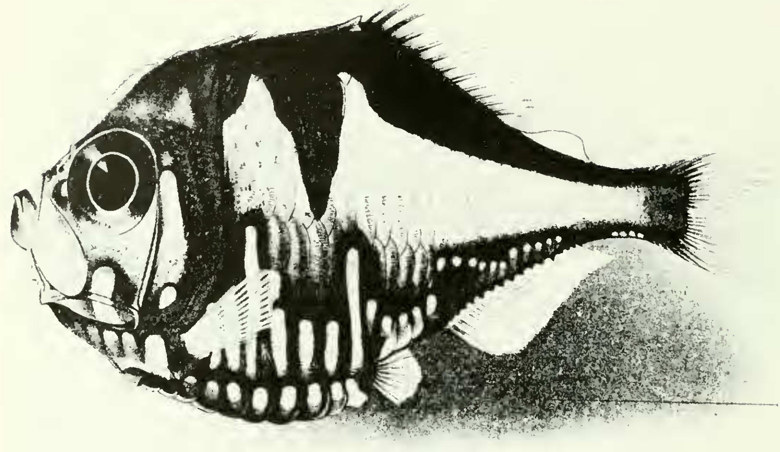


FIGURE 21.—*Polyipnus nuttingi* Gilbert. After Gilbert, 1905.

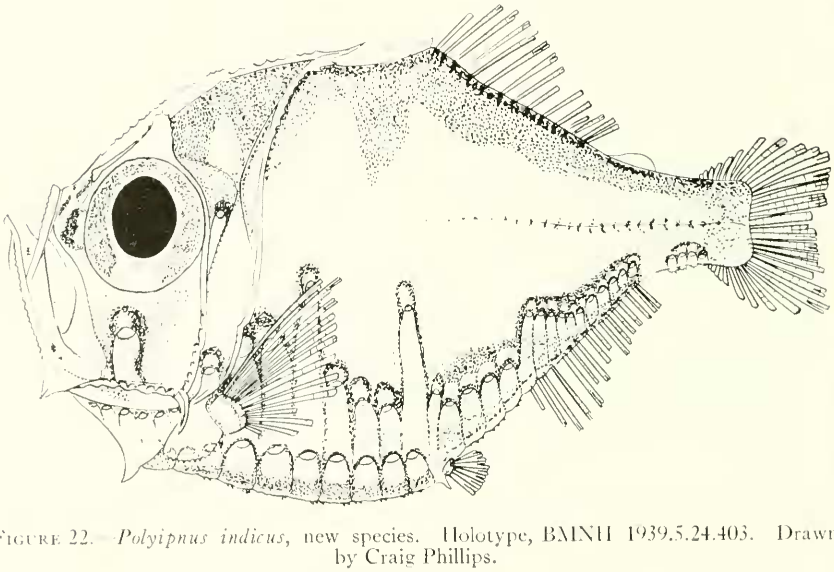


FIGURE 22.—*Polyipnus indicus*, new species. Holotype, BMNH 1939.5.24.403. Drawn by Craig Phillips.

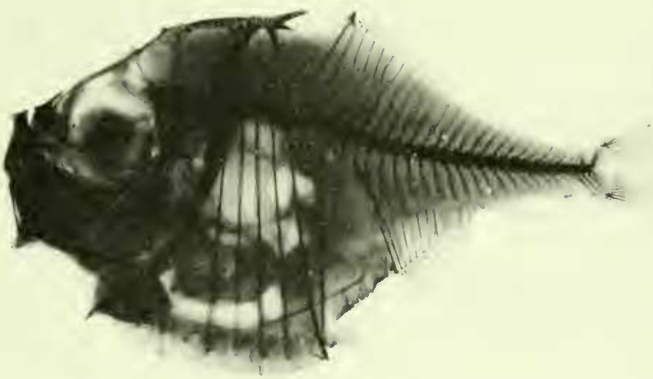


FIGURE 23.—*Polyipnus tridentifer* McCulloch. Radiograph of paratype No. E3543, of the Australian Museum

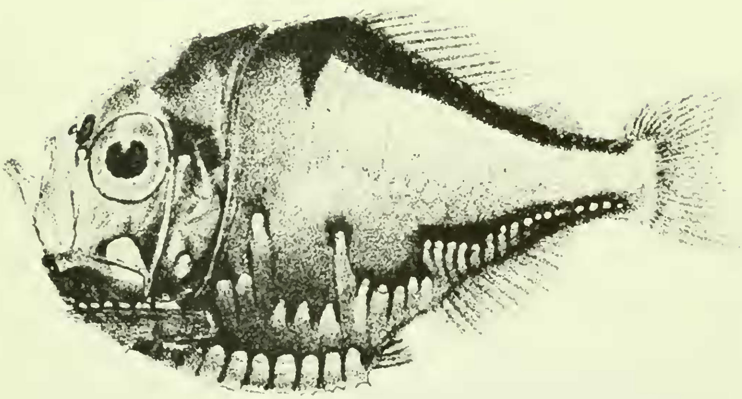


FIGURE 24.—*Polyipnus spinosus spinosus* Günther. After Günther, 1887.

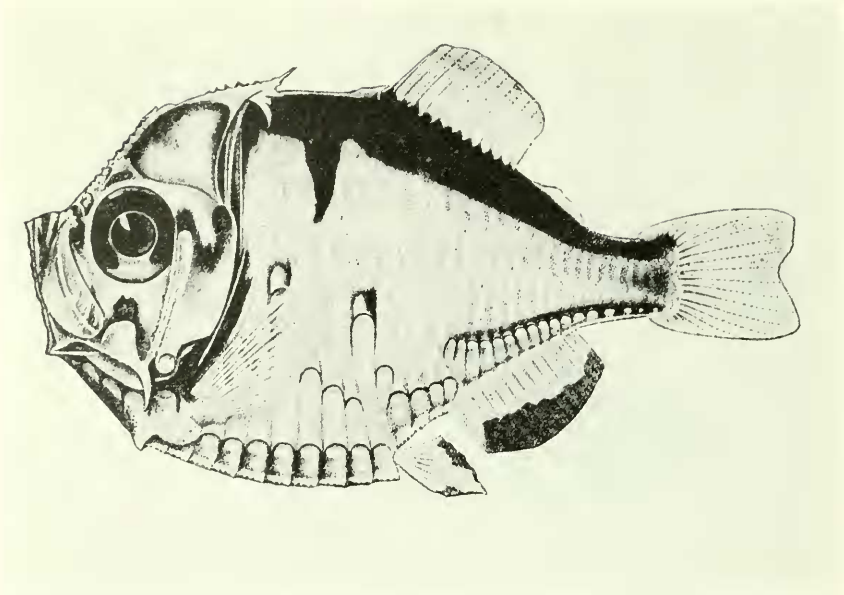


FIGURE 25.—*Polyipnus spinosus sterope* Jordan and Starks. After Jordan, Tanaka, and Snyder, 1913.

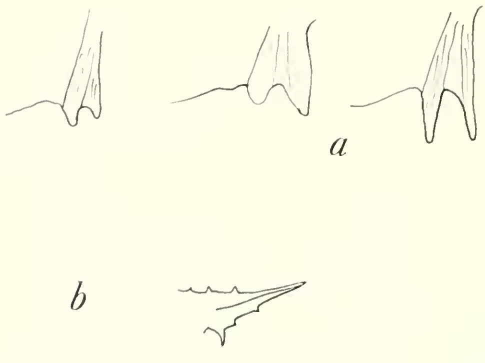


FIGURE 26.—*a*, Postabdominal spines of *Argyropelecus gigas* Norman, from sketch of Dr. N. B. Marshall of holotype and paratypes, in letter, January 21, 1958; *b*, posttemporal spine of holotype of *Polyipnus spinosus* Günther, from sketch of J. R. Norman, in letter, April 15, 1937.

Polyipnus polli, new species

FIGURE 13

Polyipnus laternatus (non Garman), Poll, Expédition océanographique Belge dans les eaux côtières Africaines de l'Altantique sud, 1948–1949, Resultats scientifiques, vol. 4, fasc. 2, Poissons, pt. 3, p. 65, fig. 27, 1953 (eastern South Atlantic off Angola).—Norman, *Discovery* reports, vol. 2, p. 305, ? fig. 14, 1930 (lat. 5°54′ N., long. 11°19′ E.; lat. 13°25′ N., long. 18°22′ W.).

HOLOTYPE: KMMA 95092, Eastern Atlantic Ocean, lat. 6°8′ S., long. 11°24′ E., depth 350 to 380 meters, standard length 22 mm.

PARATYPES: KMMA 95091, Eastern Atlantic Ocean. lat. 5°53′ S., long. 11°28′ E., depth 310 to 360 meters, 1 specimen, standard length 22.5 mm. USNM 179878, lat. 11°53′ S., long. 15°26′ E., depth 480 to 510 meters, Dec. 18, 1948, 1 specimen, 26 mm. IRSNB 8675, lat. 5°15′ S., long. 11°29′ E., depth 225 to 240 meters, 1 specimen about 17 mm., in poor condition. IRSNB 8687, lat. 8°28′ S., long. 12°54′ E., depth 310 meters, 1 specimen, about 21 mm., in very bad condition. IRSNB 8671, lat. 5°53′ S., long. 11°28′ E., depth 310 to 360 meters, 1 specimen, 17.7 mm.

DESCRIPTION: Measurements made on the holotype and paratype are given in table 7, p. 638; counts made are given in table 1, p. 591, and table 6, p. 636.

COLOR: The color pattern is shown in figure 13, p. 628.

RANGE: This species is known from the eastern South Atlantic off Anglo, Africa, at a depth of 225 to 510 meters.

REMARKS: This species is most closely related to *asteroides* and *laternatus*, both known from the Atlantic Ocean. It differs from them in having only seven anal photophores, a deeper body, and a deeper caudal peduncle, as is shown in the following tabulation:

	polli	*laternatus*	*asteroides*	*matsubarai*
Greatest depth of body in length of body without head	0.9 to 1.0	1.1 to 1.4	1.1 to 1.4	1.1 to 1.2
Width of group of anal photophores in greatest depth of body	4	3	3	2.4 to 2.8
Least depth of caudal peduncle in length of body without head	5.3 to 6.4	6.5 to 7	6.5 to 7	5.8 to 6.5

This species is distinguished in the key on p. 621 from all other known species in the genus. It is named *polli* in honor of my esteemed colleague, Dr. Max Poll, who loaned the specimens to me for study.

577377—61——4

TABLE 6.—*Counts recorded for species and subspecies of* Polyipnus

Species and subspecies	Number of anal photophores														Total number of fin rays																		
															Dorsal							Anal							Pectoral				
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	11	12	13	14	15	16	17	13	14	15	16	17	18	19	12	13	14	15	16
polli	—	—	2	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	—	—	—	1	3	—	—	—	—	3	2	—	—
laternatus	—	—	—	—	—	—	1	10	4	1	—	—	—	—	—	—	2	8	1	—	—	—	—	—	5	7	—	—	—	—	4	—	—
triphanos	—	—	—	—	1	3	—	—	—	—	—	—	—	—	2	2	—	—	—	—	—	—	—	—	—	2	1	1	—	2	2	—	—
asteroides	—	—	—	—	9	58	7	—	—	—	—	—	—	—	—	—	—	5	20	6	1	—	—	2	16	14	3	—	3	7	9	3	—
matsubarai	—	—	—	—	—	5	—	—	—	—	—	—	—	—	—	4	1	—	—	—	—	—	—	—	—	5	—	—	1	4	—	—	—
fraseri	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1?	—	—	—	—	—	—	1	—	—
japonicus	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	—	—	—	—	1	—	—	—
unispinus	—	—	—	—	—	—	—	4	1	2	—	4	—	—	—	4	4	1	—	—	—	3	4	2	—	—	—	—	5	3	—	—	—
nuttingi	—	—	—	—	—	—	1	17	5	—	—	—	—	—	—	1	16	4	—	—	—	—	—	10	10	1	—	—	1	8	1	—	—
indicus	—	—	—	—	—	—	—	2	1	—	—	—	—	—	—	—	1	2	—	—	—	—	—	2	1	—	—	—	—	2	1	—	—
tridentifer																																	
Australia (cotypes)	—	—	—	—	—	—	—	—	—	—	1	4	2	3	—	—	7	3	—	—	—	—	—	—	4	4	2	—	2	4	2	—	—
Philippines	—	—	—	—	—	—	—	—	—	2	12	21	5	—	—	—	16	2	—	—	—	—	—	2	19	4	—	—	1	7	—	—	—
Japan	—	—	—	—	—	—	—	—	—	—	3	1	—	—	—	1	2	1	—	—	—	—	—	1	2	1	—	—	9	74	18	1	—
spinosus																																	
spinosus	—	—	—	—	—	—	—	—	3	14	2	—	—	—	—	1	15	4	1	—	—	—	2	11	5	4	—	—	—	6	5	1	—
sterope	—	—	—	—	—	—	—	—	1	3	—	—	—	—	—	—	4	—	—	—	—	—	—	2	2	—	—	—	—	6	14	14	1

Species and subspecies	Number of gill rakers on first arch: Above angle							Below angle													Total																		
	4	5	6	7	8	9	10	6	7	8	9	10	11	12	13	14	15	16	17	18	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
polli	—	—	—	2	2	—	—	—	—	—	—	—	—	—		3	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	1	—	—	—	—	—
laternatus	—	1	8	5	—	—	—	—	—	—	—	—	—	—	6	4	5	—	—	—	—	—	—	—	—	—	—	—	1	4	1	2	1	—	—	—	—	—	—
triphanos	—	5	—	1	—	—	—	—	—	—	1	1	3	1	—	—	—	—	—	—	—	—	—	—	1	1	4	—	—	1	—	—	—	—	—	—	—	—	—
asteroides	—	4	5	19	2	—	—	—	—	—	—	—	—	—	7	15	8	—	—	—	—	—	—	—	—	—	—	—	—	1	9	14	4	4	2	—	—	—	—
matsubarai	—	—	—	1	3	1	—	—	—	—	—	—	—	—		1	3	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	2	—	—	—	—
fraseri	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
japonicus	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
unispinus	7	1	—	—	—	—	—	1	5	2	—	—	—	—	—	—	—	—	—	—	1	4	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
nuttingi	—	—	—	16	8	—	—	—	—	—	—	—	—	—	—	4	16	4	—	—	—	—	—	—	—	—	—	—	—	—	—	2	8	11	3	—	—	—	—
indicus	—	—	—	3	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—
tridentifer																																							
Australia (co-types)	—	—	1	6	3	—	—	—	—	—	—	—	—	—	—	3	3	3	1	—	—	—	—	—	—	—	—	—	—	—	—	4	1	2	2	1	—	—	—
Philippines	—	—	—	11	1	—	—	—	—	—	—	—	—	3	3	1	2	—	—	—	—	—	—	—	—	—	—	—	—	1	3	1	1	1	—	—	—	—	—
Japan	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—	1	2	1	—	—	—	—	—	—	—	—	—	—	—	2	18	36	31	12	1	—	—	—
spinosus																																							
spinosus	—	—	7	8	—	—	—	—	—	—	—	—	—	9	6	—	—	—	—	—	—	—	—	—	—	—	—	—	4	8	3	—	—	—	—	—	—	—	—
sterope [a]	—	—	—	—	—	4	2	—	—	—	—	—	—	—	—	—	—	2	2	2	—	—	—	—	—	—	—	—	—	—	—	—	1	6	8	11	5	6	3

[a] Some counts taken from literature.

TABLE 7.—*Measurements recorded for certain species of* Polyipnus, *expressed in thousandths of standard length*

Characters	*polli*		*matsubarai*					*japonicus*	*indicus*		
	Holotype	Paratype	Holotype	Paratypes				Holotype	Holotype	Paratypes	
Standard length in millimeters	22	22.5	64	59	45	54	51.5	12.5	47	38.2	46.2
Greatest depth of body	659	644	610	576	600	580	611	664	630	618	639
Least depth of caudal peduncle	123	102	117	108	107	96	113	102	115	110	106
Length of caudal peduncle	127	107	131	136	156	135	169	168	138	160	145
Postorbital length of head	95	107	141	136	129	130	140	96	87	99	97
Length of posttemporal spine	45	44	30	41	36	28	39	16	75	94	87
Length of preopercular spine	23	31	19	17	16	13	27	40	43	42	43
Head	345	356	328	317	322	309	349	360	338	341	368
Snout	91	—	70	76	82	72	74	56	74	71	74
Eye	182	178	160	151	145	137	153	200	177	170	184
Tip of snout to rear of maxillary	318	—	241	227	222	222	237	240	255	257	282
Bony interorbital space	68	58	75	75	76	70	70	120	60	50	54
Tip of snout to dorsal origin	554	609	562	542	566	519	552	560	618	624	624
Length of dorsal fin base	232	240	227	254	225	235	240	192	234	238	249
Length of anal fin base	273	289	289	288	300	287	310	256	232	257	221
Occiput to dorsal origin	213	236	263	268	276	245	252	200	349	342	335
Distance between anal and subcaudal groups of photophores	59	62	47	54	71	56	62	152	51	37	39
Width of subcaudal group of photophores	55	49	58	68	82	61	70	80	62	58	63

Polyipnus laternatus Garman

FIGURE 14

Polyipnus laternatus Garman, Mem. Mus. Comp. Zool., vol. 24, pp. 238, 399, 1899 (off Barbados).—Parr, Bull. Bingham Oceanogr. Coll., vol. 3, art. 7, p. 55, fig. 22, 1937 (West Indies).—Schultz, Proc. U.S. Nat. Mus., vol. 86, pp. 142–143, 1938 (West Indies).

Polyipnus spinosus Brauer (in part), Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dampfer *Valdivia*, vol. 15, pt. 1, p. 121, 1906 (Atlantic Ocean).—Rivero, Proc. Boston Soc. Nat. Hist., vol. 41, No. 4, p. 56, 1936 (off Cuba).

STUDY MATERIAL: Because of the large number of lots examined, they are summarized as follows:

Caribbean Sea 8 lots with 17 specimens; off Panama in Atlantic 1 lot, 2 specimens; off Hispaniola in Atlantic Ocean 2 lots, 2 specimens; Straits of Florida, off Cuba 10 lots, 17 specimens; off Puerto Rico 1 lot, 6 specimens; off Northern Florida in Atlantic Ocean 1 lot, 1 specimen; Western Atlantic Ocean 10 lots, 17 specimens.

Catalog numbers and number of specimens in parentheses are as follows:

BOC 3755(1) and 3756(1).

CNHM 64353(1), 64354(2), 64355(2), 64359(5), 64360(2), 64361(6), and 64362(2).

MCZ (*Atlantis* stations) 2956(1), 2960(1), 2981C(1), 2981D(2), 2985(1), 3387(1), 3404(2), 3405(3), 3425(4), and 3434(1).

UMML 2751(1).

USFWS (Brunswick, Georgia) *Combat* station 450(1).

USNM 157836(4).

DISTINCTIVE CHARACTERS: This species is close to *asteroides*, both having three supra-anal photophores; however, *laternatus* has 10 to 13 anal photophores instead of 8 to 10, as *asteroides* has, and the post-temporal spine is longer in *laternatus*, its length equal to the width of the last 4 to 7 anal photophores. The last few anal photophores of *laternatus* are smaller than are those of *asteroides*.

DESCRIPTION: Counts made are given in table 1, p. 591, and table 6, p. 636.

COLOR: The color pattern is shown in figure 14, p. 628.

RANGE: This species has been taken in the western Atlantic Ocean in the West Indies, Caribbean Sea, off Barbados, Cuba, and the north coast of Hispaniola at depths of from 240 to 1,200 fathoms. I have not seen it from the Gulf of Mexico. Specimens observed were between 18 and 40 mm. in standard length.

REMARKS: Records in the literature referring to *spinosus* from the Atlantic actually refer to *laternatus*, as I am unable to find authentic specimens of *spinosus* from the Atlantic.

Polyipnus triphanos Schultz

Figure 15

Polyipnus triphanos Schultz, Proc. U.S. Nat. Mus., vol. 86, p. 140, fig. 45, 1938 (Phillippines, holotype USNM 103027, and 2 paratypes 103028).

Study material: USNM 135519, Philippines, off Pescador Island, 295 fathoms, *Albatross* station 5190, April 1, 1908, 1 specimen, 33 mm. The three type specimens were examined.

Distinctive characters: Little, except number of vertebrae, can be added to my 1938 description of this species as only one additional specimen is available. It is distinguished by having 11 or 12 dorsal rays and 9 to 12 gill rakers on lower part of first arch, fewer than occur in other species with 3 supra-anal photophores.

Description: Counts made are given in table 1, p. 591, and table 6, p. 636.

Color: The color pattern is shown in figure 15, p. 629.

Range: Philippine Islands to a depth of 295 fathoms.

Polyipnus asteroides Schultz

Figure 16

Polyipnus asteriodes Schultz, Proc. U.S. Nat. Mus., vol. 86, p. 138, fig. 44, 1938 (West Indies and Gulf of Mexico).

Polyipnus laternatus Nichols and Breder, Proc. Biol. Soc. Washington, vol. 37, p. 21, 1924 (Gulf of Mexico).—Jespersen *in* Joubin, Faune ichthyologique de l'Atlantique nord, Paris, No. 15, fig., 1934 (on Norman, Atlantic).—Fowler, Bull. Amer. Mus. Nat. Hist., vol. 70, No. 2, p. 1206, 1936 (Atlantic).—Marshall, Aspects of deep-sea biology, New York, pp. 111, 277, middle fig. V, 15, 1954 (Atlantic).

Study material: Because of the large number of lots examined, they are summarized as follows:

Gulf of Mexico, 21 lots totaling 83 specimens; Caribbean Sea, 4 lots, 5 specimens; off Northern Florida in Atlantic Ocean, 2 lots, 3 specimens; Straits of Florida off Cuba, 3 lots, 18 specimens; off Puerto Rico, 4 lots, 25 specimens; Virgin Islands east of St. Croix, 1 lot, 2 specimens; off mouth of Orinoco River, 1 lot, 1 specimen; off British Guiana, 1 lot, 2 specimens; and Western Atlantic, 3 lots, 18 specimens.

Catalogue numbers and number of specimens in parentheses are as follows:

CNHM 45737(5), 46276(7), 46277(2), 64350(18), 64351(1), 64357(1), 64358(1), and 64368(3).

MCZ (*Atlantis* stations) 2981(1), 2982(2), and 3424(16).

UMML 1399(1), 1906(1), 2325(1), and 2331(2).

USFWS (Brunswick, Ga.) 3 lots, 4 specimens.

USNM 86131(1), 102978(4), 157901(15), 158080(2), 186016(5), 186017(3), 186018(1), 186019(4), 186020(4), 186022(5), 186023(1), 186024(1), 186025(2).

Distinctive characters: This species is best distinguished by having 3 supra-anal photophores in combination with 14 to 17 dorsal

rays, 8 to 10 anal photophores, and a very short posttemporal spine, its length equal to width of only 1 or 2 anal photophores.

Description: Counts made are given in table 1, p. 591, and table 6, p. 636.

Color: The color pattern is shown in figure 16, p. 629.

Range: This species is known from the Western Atlantic Ocean, off the eastern coast of Florida, Gulf of Mexico, Caribbean Sea, off Nicaragua, off Costa Rica, off Puerto Rico, off British Guiana and Trinidad at depths of 200 to 600 fathoms. Specimens observed are from 19 to 71 mm. in standard length.

Remarks: Matsubara (Suisan Kenkiu-Shi, Japan, vol. 36, No. 1, p. 2, 1941; Japanese Journ. Ichthy., vol. 1, No. 3, p. 192, fig. 3, 1950) reported *P. asteroides* from Japan, but when I examined his specimens, collected at a later date, I found them to differ from *P. asteroides* of the Western Atlantic; therefore, the Japanese specimens represent a distinct species, described immediately below.

Polyipnus matsubarai, new species

Figure 17

Polyipnus asteroides, Matsubara, Suisan Kenkiu-Shi, Japan, vol. 36, No. 1, p. 2, 1941 (near Kambara, Numazu Sizuoka Prefecture, Japan); Japanese Journ. Ichthy., vol. 1, No. 3, p. 192, figs. 3, 4B, 5B, 6, 1950 (Kambara, near Numazu).

Polyipnus stereope, Kuroda, Botany and Zoology, vol. 3, No. 4, p. 831, 1935 (Suruga Bay, Japan).—Oshima, Hattore Hôkokai Kenkiu Shôroku, No. 5, p. 283, 1938 (Sagami Bay).

Holotype: USNM 179793 collected by K. Suzuki at Kumanonada, Japan, standard length 64 mm.

Paratypes: Collected with holotype and bearing same data, 3 specimens, standard lengths 45 to 59 mm., deposited at Kyoto University, Maizuru, Japan. USNM 179794 collected with the holotype, standard length 51.5 mm.

Description: Measurements made on the holotype and four paratypes are given in table 7, p. 638; the counts made are given in table 1, p. 591, and table 6, p. 636.

Color: The color pattern is shown in figure 17, p. 630.

Range: This species has been found only in Japanese waters.

Remarks: This species is most closely related to *P. asteroides* in having about the same number of anal photophores, anal rays, and gill rakers, but differs in having only 12 or 13 total dorsal rays instead of the 14 to 17 that occur in *P. asteroides*. In addition the color pattern of *P. matsubarai* differs from that of *P. asteroides* in the wedge shaped dark bar a little behind the head being narrow and reaching ventrally to the midlengthwise axis of body, whereas in *P. asteroides* this wedge shaped bar is broad and reaches only halfway to the midlengthwise axis of body. Behind this dark bar a light or white inter-

space reaches to the middorsal line on *P. matsubarai* but is absent on *P. asteroides*.

From the other related species *matsubarai* may be distinguished by use of the key to the species of *Polyipnus* on p. 621.

Dr. Tamotsu Iwai writes that all of the specimens used in Matsubara's 1941 and 1950 reports were destroyed by fire.

Since the accounts of Kuroda and of Oshima are in Japanese, Dr. Matsubara has kindly translated them for me, as follows:

Kuroda, N., 1935: On rare fishes contained in Suruga-Wan Marine Biological Laboratory. Botony and Zoology 3(4): 830–831.

Polyipnus stereope Jordan and Starks

Honen-eso (Japanese name) Sternoptychidae.

This is the famous luminous fish and the body is roundish in outline. It also is called Honen-uo. Several specimens.

Oshima, M., 1938: Preliminary report on the results of investigation of deep-sea fishes obtained from Suruga Bay. Hattori Hôkokai Kenkiu Shôroku, (5): 281–285.

Family Sternoptychidae

Polyipnus sterope Jordan and Starks, Honen-eso

Locality. Off Yaizu, Shizuoka, Pref., depth 100–200 m. The present species has been ascertained as the new species by Jordan and Starks based upon three specimens obtained from deep water of Sagami Bay. This species is very rare and generally is considered difficult to obtain. Only single specimens have been obtained together with luminous shrimps, but this is the new record from Suruga Bay.

Oshima misspelled *P. stereope* Jordan and Starks.

This new species is named *matsubarai* in honor of my esteemed colleague, Dr. Kiyomatsu Matsubara, who loaned the specimens for study.

Polyipnus fraseri Fowler

FIGURE 18

Polyipnus fraseri Fowler, Proc. Acad. Nat. Sci. Philadelphia, vol. 85, p. 257, fig. 19, 1934 (holotype USNM 92324, lat. 12°56′24″ N., long. 124°25′24″ E., *Albatross* station 5476, and not as published by Fowler).—Schultz, Proc. U.S. Nat. Mus., vol. 86, pp. 142, 145, 1938 (Philippines).

STUDY MATERIAL: Only known from the holotype.

DISTINCTIVE CHARACTERS: This species, along with *japonicus*, has only four anal photophores, fewer than occur in any other species in the genus. The posttemporal spine is long and strong, with two shorter but strong spines arising basally, and the posterior bony edges of both supracleithrum and preopercle are serrated.

DESCRIPTION: Counts made are given in table 1, p. 591, and table 6, p. 636.

COLOR: The color pattern is shown in figure 18, p. 630.

RANGE: This species is known from the Philippine Islands.

Polyipnus japonicus, new species

FIGURE 19

HOLOTYPE: SIO H53–367, Kii Strait, Japan, Oct. 23–24, 1953, midwater trawl by *S. F. Baird*, standard length 12.5 mm.

DESCRIPTION: Measurements made on the holotype, the only known specimen, are given in table 7, p. 638; the counts made are given in table 6, p. 636.

COLOR: The color pattern is shown in figure 19, p. 631.

RANGE: This species is known only from Japan.

REMARKS: This species along with *P. fraseri* is characterized by having only four anal photophores, fewer than any other species of *Polyipnus*. *P. japonicus* is most closely related to *P. fraseri* but differs from that species as follows:

The posttemporal spine in *P. japonicus* is simple, very small, and without spines arising from its side or the base whereas the posttemporal spine in *fraseri* is long, strong, and has two strong basal spines; the posterior edge of both the supracleithrum and bony preopecle are serrated in *fraseri* whereas they are smooth in *japonicus*; the lower bony edge in both species is serrated. Although there are a few minor differences in body proportions between the two species, these might result from the great differences in size. The length of the posttemporal spine, however, is usually proportionately longer in small specimens of *Polyipnus* than in the larger specimens of the same species; hence, I conclude that the spine of *japonicus*, only 16 thousandths of the standard length, is significantly shorter than that of *fraseri*, which is 160 thousandths.

The first two pair of abdominal photophores in *fraseri* are out of line with the others, whereas in *japonicus* all abdominal photophores are in line, as is usual in *Polyipnus*. I presume the unusual arrangement of abdominal photophores in *fraseri* may be an abnormality.

Radiographs of this species did not show vertebrae clearly to enable me to make a count; therefore, this species is not included in table 1.

The species is named *japonicus* in reference to the region where the holotype was collected.

Polyipnus unispinus Schultz

FIGURE 20

Polyipnus unispinus Schultz, Proc. U.S. Nat. Mus., vol. 86, p. 137, fig. 43, 1938 (Philippines).

STUDY MATERIAL: Holotype, USNM 103153, *Albatross* station 5451, lat. 13°22′22″ N., long. 124°00′48″ E., depth 380 fathoms, June 5, 1909, 20.5 mm. standard length. Paratypes, USNM 103029, same data as holotype, 5 specimens, 16 to 19 mm. Nontypes,

USNM 135517, *Albatross* station 5287, lat. 13°37′40″ N., long. 120°39′ E., depth 379 fathoms, July 20, 1908, 5 specimens, 26 to 31 mm.

Distinctive characters: This species, without the group of supra-anal photophores but with 11 to 15 anal ones, has an unusually small number of gill rakers (a total of only 10 to 12 on the first arch); the posttemporal spine is long, slender, and simple and its length is always greater than the diameter of the pupil. The greatest depth is twice the standard length.

Description: Counts made are given in table 1, p. 591, and table 6, p. 636.

Color: The color pattern is shown in figure 20, p. 631.

Range: This species is known from the Philippines at a depth of about 380 fathoms.

Polyipnus nuttingi Gilbert

Figure 21

Polyipnus nuttingi Gilbert *in* Jordan and Starks, Bull. U.S. Fish Comm. 1902, vol. 22, p. 581, 1904 (Hawaiian Islands).—Gilbert, Bull. U.S. Fish. Comm. 1903, vol. 23, pt. 2, p. 609, pl. 73, 1905 (Holotype USNM 51599, Hawaiian Islands).—Jordan and Seale, Bull. U.S. Bur. Fish. 1905, vol. 25, p. 180, 1906 (Hawaii).—Jordan, Proc. U.S. Nat. Mus., vol. 59, p. 646, 1921) Hilo, Hawaii).—Jordan and Jordan, Mem. Carnegie Mus., vol. 10, No. 1, p. 9, 1922 (Hawaiian Islands).—Fowler, Mem. Bernice Pauahl Bishop Mus., vol. 10, p. 35, 1928 (Hawaiian Islands); Acad. Nat. Sci. Philadelphia, monogr. No. 2, p. 265, 1938 (Hawaiian Islands).—Schultz, Proc. U.S. Nat. Mus., vol. 86, p. 145, 1938 (USNM 51693 not 51593 as published, see remarks below).—Fowler, Mem. Bernice Pauahl Bishop Mus., vol. 12, No. 2, p. 42, 1949 (Hawaiian Islands).—Böhlke, Stanford Ichthy. Bull., vol. 5, p. 17, 1953 (list of paratypes).—Haig, Pacific Sci., vol. 9, p. 319, 1955 (Hawaiian Islands).

Polyipnus spinosus (non Günther), Gilbert and Cramer, Proc. U.S. Nat. Mus., vol. 19, p. 416, 1897 (USNM 47720, Hawaii).

Study material: USNM 51599, Hawaiian Islands, Pailolo Channel between Molokai and Maui, 297 to 306 fathoms, *Albatross* station 4088. USNM 47720, Hawaiian Islands, lat. 21°09′ N., long. 157°53′ W., depth 298 fathoms, standard length 41 mm. USNM 177912, Hawaiian Islands, *Albatross* station 1902, 2 specimens, 58 and 60 mm. SNHM 8518 (paratypes), Hawaiian Islands, *Albatross* stations 3867, 4077, 4090, and 4121, 6 specimens, 37 to 71 mm.

Distinctive characters: This species lacks the group of supra-anal photophores and has a very short but strong posttemporal spine, its length shorter than the diameter of the pupil; the gill rakers on the first arch total 21 to 24, usually 22 or 23; anal photopores total 10 to 12, usually 11.

Description: Counts made are given in table 1, p. 591, and table 6, p. 636.

Color: The color pattern is shown in figure 21, p. 632.

Range: This species is known from the Hawaiian Islands; records in the literature from other areas are probably for other species.

Remarks: In 1938 I published USNM 51593 with *Albatross* station No. 4102, an error as far as *P. nuttingi* is concerned because futher investigation of USNM 51593 shows that this number belongs to a specimen of *Antigonia eos* and that the correct USNM number is actually 51693; this lot is labeled as cotypes of *P. nuttingi* in Gilbert's handwriting in the jar. No *Albatross* station number, however, was found in the jar, and now it appears that when the cotypes were returned from Stanford University, those from *Albatross* stations 3867, 3920, 4089, 4090, 4091, 4097, 4121, and 4134 were all placed in one package. To each specimen is attached a small paper tag with a number, perhaps corresponding to Gilbert's notes, which I have not seen. Later, 2 specimens from this lot were received from the University of Iowa, and 6 were sent on exchange to the Chicago Natural History Museum, a total of 29 specimens now being left.

Polyipnus indicus, new species

Figure 22

Polyipnus nuttingi (non Gilbert), Norman, John Murray Expedition, 1933–34, Scientific reports, vol. 7, No. 1, p. 20, 1939 (Zanzibar Area).

Holotype: BMNH 1939.5.24.403, station 115, John Murray Expedition Zanzibar Area, depth 640 to 658 meters, standard length 47 mm.

Paratypes: BMNH 1939.5.24.404, same data as holotype, 1 specimen, 38.2. USNM 179897, same data as holotype, 1 specimen, 46.2 mm.

Description: Measurements made on the holotype and two paratypes are given in table 7, p. 638; counts made are given in table 1, p. 591, and table 6, p. 636.

Color: The color pattern is shown in figure 22, p. 632.

Range: This species is known only from the area off Zanzibar.

Remarks: This species is most closely related to *P. nuttingi* of the Hawaiian Islands region. It differs in having only 20 gill rakers, whereas *nuttingi* has from 21 to 24, usually 22 or 23. Furthermore, the distance between the anal and subcaudal groups of photophores is notably greater than the width of the subcaudal photophores in *nuttingi* but shorter in *indicus*, as is indicated in the following tabulation:

	Width of subcaudal group of photophores divided into the distance between anal and subcaudal groups									
	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5
nuttingi	—	—	—	—	1	1	—	4	—	2
indicus	2	—	1	—	—	—	—	—	—	—

Other differences may have significance too. The caudal peduncle is longer and more slender in *nuttingi*; its length is 160 to 213 thousandths of standard length, whereas in *indicus*, it ranges from 138 to 160. The posttemporal spine of *nuttingi* is shorter, 49 to 74 thousandths, whereas in *indicus* it is 75 to 94 thousandths. The distance from occiput to dorsal fin origin in *nuttingi* is 262 to 300 thousandths of standard length, whereas in *indicus* it is 335 to 349.

Polyipnus tridentifer McCulloch

FIGURES 1, 23

Polyipnus tridentifer McCulloch, Zoological (-biological) results of the fishing experiments carried out by the F.I.S. *Endeavour*, 1909–1910, vol. 2., pt. 3. pp. 78, 87–89, fig. 4, pt. 5, pl. 16, 1914 (Great Australian Bight, long. 129°28′ E., 350–450 fathoms).—Waite, The fishes of South Australia, Adelaide, p. 64, fig., 1923 (Great Australian Bight).—Barnard, Ann. South African Mus., vol. 21, pt. 1, p. 155, pl. 8, fig. 2, 1925 (Cape Morgan and Natal Coast, South Africa).—Whitley, A list of the fishes of Western Australia, Fisheries Dep., Western Australia, Fisheries Bull. No. 2, p. 11, 1948 (Australia).—Munro, Handbook of Australian fishes, No. 7, p. 31, fig. 220, 1957 (on McCulloch).

Polyipnus spinosus, Brauer (in part), Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dampfer *Valdivia*, 1898–1899 . . ., vol. 1, pt. 1, p. 121, figs. 64–66, 1906 (between Borneo and Philippines, Andaman Sea, Sumatra); pt. 2, p. 30, pl. 24, figs. 9–15, 1908 (anatomy).—Fowler, Bull. Amer. Mus. Hist., vol. 70, pt. 1, p. 240, fig. 112, 1934 (on Brauer and on Weber and Beaufort).—Schultz (in part), Proc. U.S. Nat. Mus., vol. 86, pp. 143–144, 1938 (Philippines, Moluccas, Celebes Sea, China Sea, Japan).—Matsubara, Suisan Kenkiu-Shi, Japan, vol. 36, No. 1, p. 2, 1941 (Japan); Japanese Journ. Ichthy. vol. 1, No. 3, p. 188, fig. 2, 1950 (Japan).—Okada and Suzuki, Pacific Sci., vol. 10, pp. 296–302, figs. 1–7, 1956 (Japan).

STUDY MATERIAL: The following specimens (all USNM catalog numbers with the number of specimens given in parentheses) were examined:

Andaman Sea: 44429(1).
Celebes Sea: 103041(1), 103055(1), 103056(2), 103057(1).
China Sea: 135523(4) and 135526(17).
Japan: 102980(2), 102982(2), and 149520(1).
Moluccas: 135537(17).
Philippine Islands: 103033(1), 103034(1), 103035(1), 103036(2), 103039(1), 103040(1), 103042(1), 103043(11), 103044(1), 103045(1), 103046(3), 103047(1), 103048(1), 103049(1), 103050(1), 103051(3), 103054(1), 135514(4), 135515(17), 135518(1), 135521(3), 135524(5), 135525(1), 135527(4), 135528(11), 135529(81), 135530(75), 135531(17), 135532(6), 135533(1), 135534(8), 135535(38), 135536(18).

Through the courtesy of Dr. Gilbert Whitley and J. W. Evans, The Australian Museum, Sydney, I have examined 10 of the cotypes of *Polyipnus tridentifer* McCulloch, Australian Museum No. E.3543, one of which is 72 mm. standard length and is selected as the lectotype. Although these cotypes differ slightly from specimens taken in the

Philippines and Japan, the differences observed do not appear great enough to consider them as more than somewhat distinct populations. This problem needs more material before a detailed study can be undertaken.

Distinctive characters: This species lacks the group of supra-anal photophores; the posttemporal spine is long and slender and has 1 or 2 curved smaller basal spines; the dorsally located spine is always longer than diameter of the pupil; the anal photophores total 13 to 17, rarely 13; and the caudal vertebrae usually total 24.

Description: Detailed measurements were made on 10 of the cotypes of *P. tridentifer*, kindly sent for my examination by the Australian Museum. The minimum and maximum range of these data are expressed in thousandths of the standard length. Standard lengths range from 40.3 to 73 mm.; greatest depth 592 to 682; least depth caudal peduncle 89 to 104; length of caudal peduncle between vertical lines through rear of anal base and base of midcaudal fin rays 159 to 191; length of postorbital spine 80 to 174 (this spine proportionately longer in small specimens than in larger ones); length of preopercular spine 46 to 84; length of head 318 to 362; diameter of eye 161 to 183; length from snout tip to rear of maxillary 236 to 268; width of bony interorbital 70 to 83; snout tip to dorsal origin 550 to 600; occiput to dorsal origin 277 to 320; length of dorsal fin base 164 to 239; length of anal fin base 233 to 283; distance between anal and caudal groups of photophores 4 to 10; width of group of caudal photophores.

Counts made are given in table 1, p. 591, and table 6, p. 636.

Range: This species has been recorded from the Great Australian Bight, Moluccas, Andaman Sea, Celebes Sea, Philippines, China Sea, Japan and off Cape Morgan and Natal, and South Africa at depths of from 37 to 450 fathoms; however, it has been taken most frequently at depths of from about 100 to 300 fathoms.

Polyipnus spinosus spinosus Günther

Figures 24, 26*b*

Polyipnus spinosus Günther, Report of the scientific results of the voyage of H.M.S. *Challenger* during 1873–76, vol. 22, p. 170, pl. 51B, 1887 (type locality, between Philippine Islands and Borneo, station 200, depth 250 fathoms).—Alcock, Ann. Mag. Nat. Hist. ser. 6, vol. 4, p. 398, 1889 (Bay of Bengal, on Günther).—Wood-Mason and Alcock, Ann. Mag. Nat. Hist. ser. 6, vol. 8, p. 126, 1891 (Bay of Bengal).—Alcock, Journ. Asiatic Soc. Bengal vol. 65, pt. 2, p. 331, 1896 (off Andaman Islands); A descriptive catalogue of the Indian deep-sea fishes in the Indian Museum . . . , Calcutta, p. 138, 1889 (on Günther).—Weber, Die Fische der Siboga-Expedition, Lieden, vol. 57, p. 21, 1913 (East Indies).—Weber and Beaufort, The fishes of the Indo-Australian archipelago, vol. 2, p. 130, fig. 47, 1913 (East Indies).

—Roxas, Philippine Jour. Sci., vol. 55, No. 3, p. 286, 1934 (on Günther). —Schultz (in part), Proc. U.S. Nat. Mus., vol. 86, pp. 142–144, 1938 (Philippines and Celebes Sea).—Smith, The sea fishes of southern Africa, p. 106, fig. 159, 1949 (Natal to the Cape).—Harvey, Bioluminescence, New York, pp. 512, 540, 542, 1952 (light organs).—Koumans, Temminckia, Lieden, vol. 9, p. 185, 1953 (lat. 8°39′ S., 130°35′ E.).

Study material: The following specimens (all in USNM) were examined:

Flores Sea: 103059(1).
Moluccas: 103058(2) and 135522(2).
Philippine Islands: 103037(1), 103038(1), 103052(2), 103053(1), 135516(1), 135520(3), 177892(1), 177893(2), 177894(1).

Description: Counts made are given in table 1, p. 591, and table 6, p. 636.

Color: The color pattern is shown in figure 24, p. 633.

Range: This species is known from the Philippines, Celebes Sea, Flores Sea, Moluccas, East Indies, Andaman Islands, Bay of Bengal, and off Natal to Cape of Good Hope at a depth of from 100 to 303 fathoms.

Remarks: There has been much confusion concerning the actual speciation and nomenclature of the *Polyipnus spinosus* complex (Schultz, 1938; pp. 141–145; and Okada and Suzuki, Pacific Sci., vol. 10, pp. 296–302, 1956). The latter authors have presented a clear case that two distinct species of *Polyipnus* occur in Japanese waters. These two species may be distinguished by one having a more robust body behind dorsal fin and a deeper caudal peduncle, more gill rakers, and more pectoral fin rays. This species is called by them *P. stereope*, whereas the other is referred to as *P. spinosus*.

In the U.S. National Museum I have studied this complex of species again and now have a much larger series and more experience to call on than in 1938. I find that Okada and Suzuki are correct in that two species do occur in Japanese waters, but they have incorrectly applied the nomenclature. A study of Günther's drawing of the holotype of *P. spinosus* indicates a species with a robust caudal peduncle and only 13 anal photophores. These two characters are present in all specimens from the Philippines having a short posttemporal spine like that illustrated for the type of *P. spinosus* by the late J. R. Norman and sent to me in a letter dated April 15, 1937, and herein reproduced as figure 26*b*, p. 634.

In studying the types of *P. stereope* Jordan and Starks, however, I find they too have a robust body, robust caudal peduncle, and only 13 anal photophores, along with a relatively short posttemporal spine. Thus, *P. stereope* and *P. spinosus* form a species complex and, by means of data presented by Okada and Suzuki along with additional data from specimens in the U.S. National Museum, I am able to

distinguish two subspecies: *P. spinosus spinosus* of the Philippines and Celebes Sea and *P. spinosus stereope* of Japan; see also table 6, p. 636, which gives counts for these two subspecies.

This leaves the other species in the complex, the one with a slender caudal peduncle and longer, more slender posttemporal spine, which was thought to be *P. spinosus* by Okada and Suzuki, but which is not that species.

McCulloch (Zoological (-biological) results of the fishing experiments carried out by the F.I.S. *Endeavour*, 1909–1910, vol. 2, pt. 3, pp. 78, 87–89, fig. 4, pt. 5, pl. 16, 1914) described *P. tridentifer* from off southern Australia. That species has a more slender caudal peduncle, 13 to 17 anal photophores, 15 to 18 anal rays, and 12 to 15 pectoral rays. These characters are close to those of our large series of specimens from the Philippines and Celebes Sea and must be considered as the *P. tridentifer* complex. In table 6, the specimens from Japan and the Philippines appear not to differ from the Australian *tridentifer* sufficiently to indicate subspecific populations.

The characters recorded by Okada and Suzuki (Pacific Sci., vol. 10, pp. 298–301, 1956) for their nominal species *P. spinosus*, such as 20 to 25 gill rakers, 12 to 14 pectoral rays, a more slender caudal peduncle, a long slender posttemporal spine, definitely are characters that identify their *P. spinosus* as actually *P. tridentifer*.

Polyipnus spinosus stereope Jordan and Starks

Figure 25

Polyipnus stereope Jordan and Starks, Bull. U.S. Fish Comm. 1902, vol. 22, p. 581, 1904 (Sagami Bay, Japan, holotype USNM 51451, and paratype 177895).—Jordan, Tanaka and, Snyder, Journ. College Sci. Imp. Univ. Tokyo, vol. 23, art. 1, p. 52, fig. 30, 1913 (Sagami Sea).—Haneda, Pacific Sci., vol. 6, No. 1, pp. 13–16, 1952 (Japan).—Okada and Suzuki, Pacific Sci., vol. 10, pp. 296–302, figs. 1–7, 1956 (Japan).

Polyipnus spinosus, Schultz (in part), Proc. U.S. Nat. Mus., vol. 86, pp. 143–144, 1938 (Japan).—Kamohara, Reports Kochi Univ. Nat. Sci., No. 3, p. 17, 1952 (Tosa Providence, Japan).

Study material: USNM 51451 (holotype), off Manazuru Zaki, Honshu Island, Japan, *Albatross* station 3698, depth 153 fathoms. USNM 102981, *Albatross* station 4913, lat. 31°39′10″ N., long. 129°22′30″ E., off Japan, 2 specimens, 37 and 43 mm. SNHM 8392, 1 specimen, 42 mm.

Distinctive characters: This subspecies is distinguished from *spinosus spinosus* in the discussion of the latter beginning on p. 648.

Color: The color pattern is shown in figure 25, p. 634.

Description: Counts made are given in table 1, p. 591, and table 6, p. 636.

Range: This species is known from Japan between depths of from 153 to 391 fathoms.

U. S. GOVERNMENT PRINTING OFFICE: 1961